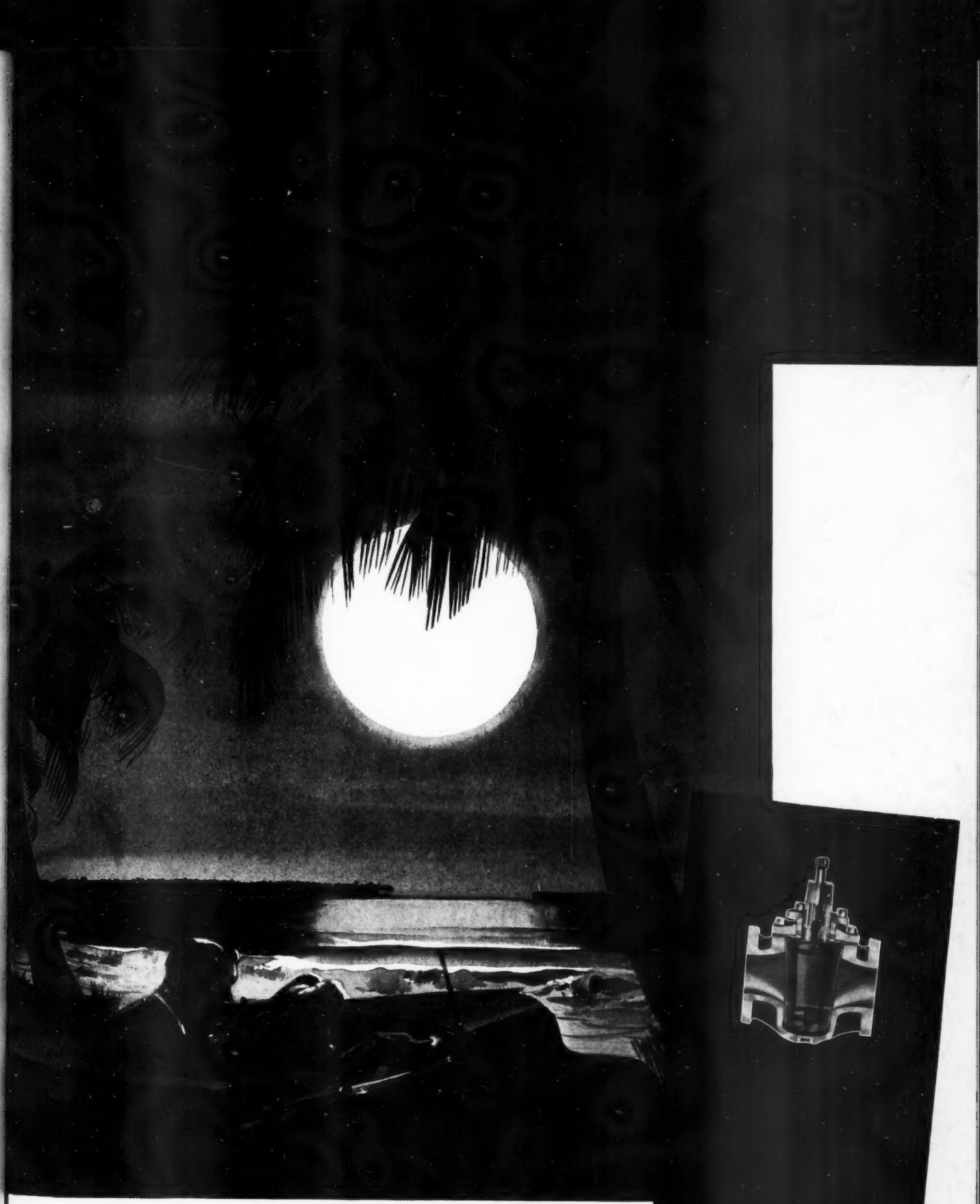

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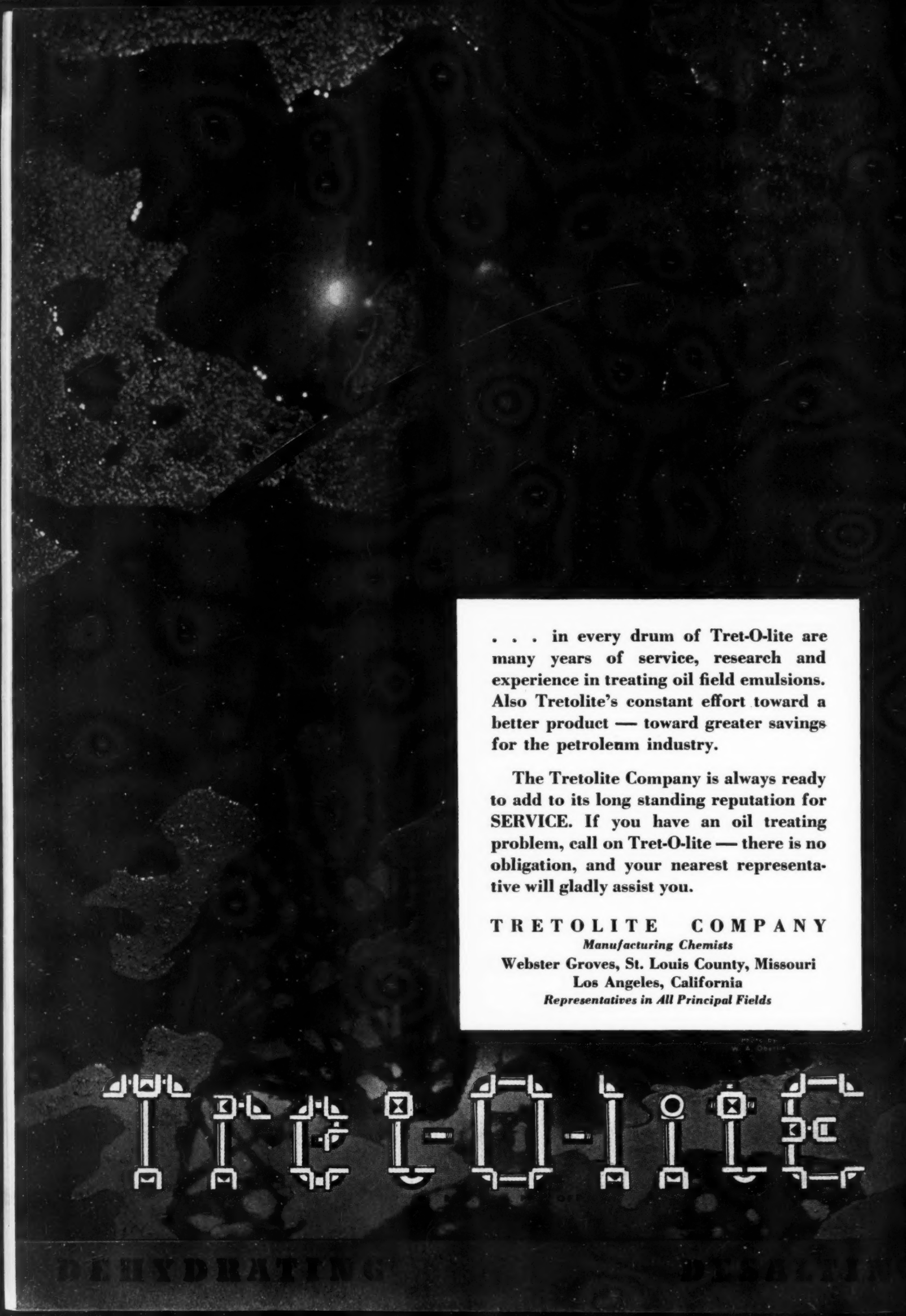

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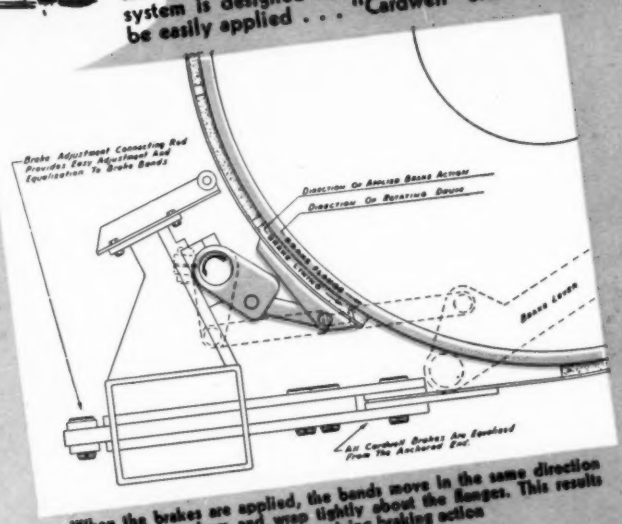
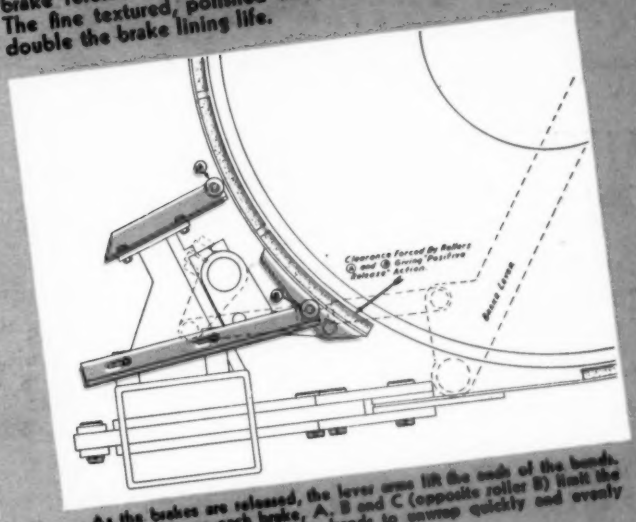
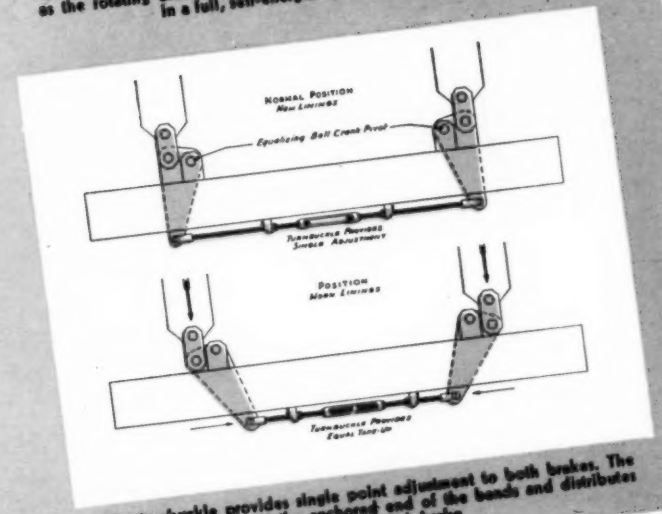

Brake Adjustment Connecting Rod Provides Easy Adjustment And Equalization To Brake Bands
Direction Of Applied Brake Action
Direction Of Rotating Drum
Brake Lining
Brake Lining Retainer
Brake Lever
All Cardwell Brakes Are Equalized From The Anchored End.

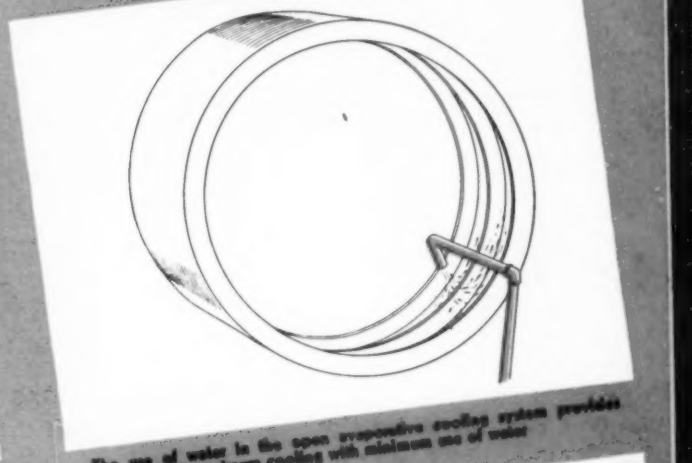
When the brakes are applied, the bands move in the same direction as the rotating drum and wrap tightly about the flanges. This results in a full, self-energizing braking action



As the brakes are released, the lever arms lift the ends of the bands. Three rollers on each brake, A, B and C (opposite roller B) limit the outward travel and cause the bands to unwrap quickly and evenly from the flanges



The turnbuckle provides single point adjustment to both brakes. The equalizer operates on the anchored end of the bands and distributes the load on each brake



The use of water in the open evaporative cooling system provides maximum cooling with minimum use of water

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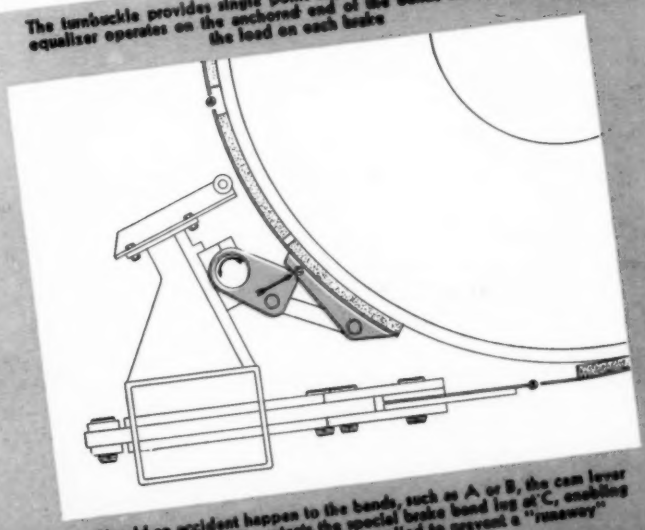

Should an accident happen to the bands, such as A or B, the cam lever would rotate until it contacts the special brake band lug at C, enabling sufficient braking pressure to be applied to prevent a "runaway"

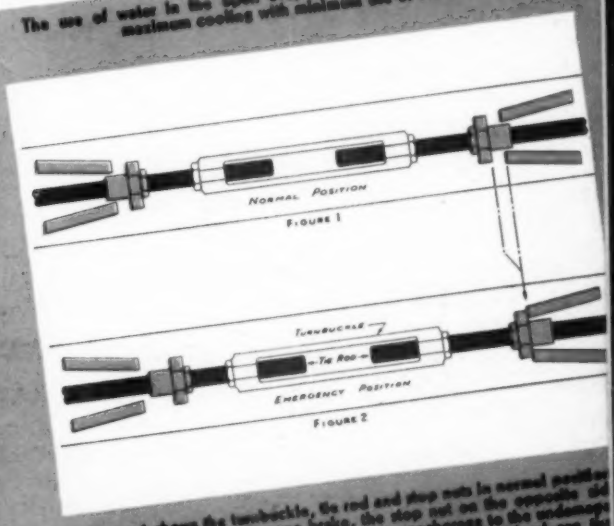

Figure 1 shows the turnbuckle, tie rod and stop nuts in normal position. If an accident occurs to one brake, the stop nut on the opposite end moves against the stop lugs and gives new anchorage to the undamaged brake, as in figure 2. Sufficient pressure to hold the load can then be applied

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The Course of Oil

by K. C. SCLATER

PRICES AND PRIORITIES

Washington officials have indicated to the oil industry that by midyear, 1942, the probable crude oil production and consumption in this country would rise to four and one-half million barrels daily. To maintain production and crude oil reserves to meet this need, it is estimated that thirty thousand new wells must be drilled during 1942. This was before we were at war with Japan and the other Axis Powers. Now that this country is at war, it is certain that the demands on the oil industry of this country will far exceed previous estimates. Immediate speeding-up of operations in all branches of the industry seems almost imperative.

Even as well prepared as the oil industry of the United States is today, a well-planned long-range program to increase its crude oil reserves, refining facilities, and its transportation and distribution systems is essential if the oil industry is to cope with the exigencies of a world-wide war like that now prevailing on land, sea, and in the air.

Fortunately, the oil industry is in position to embark on any such program that may be necessary, but it must have the full support of Washington authorities. Two things that may seriously hamper the oil industry in putting forth its greatest effort are the price situation and the matter of priorities.

As for prices, it has just been announced by the office of the OPA that a comprehensive study of crude oil costs throughout the United States is being undertaken by the Tariff Commission. Ten thousand or more questionnaires requesting information on operations are being sent to oil producers all over the country, including major companies, large and small independents, and stripper well operators. It will probably be some time in January, 1942, before these questionnaires are all returned and available for study by the authorities in Washington. How long the study will take is not known. Meanwhile, in the face of rising costs and the restrictions on critical materials and supplies, serious difficulties confront many operators if they are to keep their wells in operation and maintain production. These operators must wait until OPA officials make a decision — this regardless of the fact that several precious months have slipped by since the question of crude oil prices was brought to the attention of the OPA.

In regard to priorities and the obtaining of essential materials to carry on operations, it has just been announced (December 8) by the OPM that a broad new plan of priorities will replace that now in force. A certain quantity of steel tonnage and other critical materials will be allotted to each industry, including that of petroleum. Each industry will be allotted a definite percentage of its 1942 requirements. This conforms to an announcement by President Roosevelt that the civilian use of all materials during 1942 will be curtailed by fifty percent. It is from that percentage curtailment that defense needs must be filled.

Under the new plan, the petroleum industry will be assigned a blanket rating that will enable manufacturers to obtain necessary raw materials to met their requirements for three months ahead.

Of two new orders, one just issued applies to the suppliers of material and equipment to the petroleum industry (see pages 121 and 122, this issue); the other order, expected to be issued within a few days, will apply to the oil companies for the ordering of equipment. All suppliers will be able to obtain an A-8 preference rating. Suppliers and equipment manufacturers supplying the oil industry will be able to obtain quantities of critical materials, such materials being classified according to the requirements of the industry for defense needs. The A-8 rating will apply to all materials and equipment manufactured especially for the oil industry.

It is to be noted that all four branches of the oil industry, according to the new plan, will still require preference ratings to buy the material and equipment carried by supply houses and manufacturers. The new order for oil companies that still remains to be announced by the OPM, will probably provide for giving different preference ratings to the same equipment when used for different purposes. For example, valves and fittings to be used in drilling operations will have a different rating from similar valves and fittings to be used in refining operations. In other words, Washington defense authorities make it plain that each piece of equipment must be used for the specified purpose requested in the order.

Under this new allocation system the distribution of critical materials and equipment will be closely checked and regulated, but its prime purpose is to aid the supplier in obtaining with the least delay the supplies to which he is entitled. The other new order for oil companies is expected to serve the same purpose by aiding the oil company to obtain without delay the supplies it needs and to which it is entitled.

One of the great advantages of the new system is that a definite quantity of critical materials and equipment will be set aside for the oil industry. One of the drawbacks of the priorities system in force before this new order came out, was that preference ratings would be issued for more materials than were really available.

Now that the country is on a rigid war footing, it is imperative that the oil industry prepare for any eventuality. In order that it can put forth its fullest effort, the uncertainties regarding prices and priorities should be removed at the earliest possible moment.

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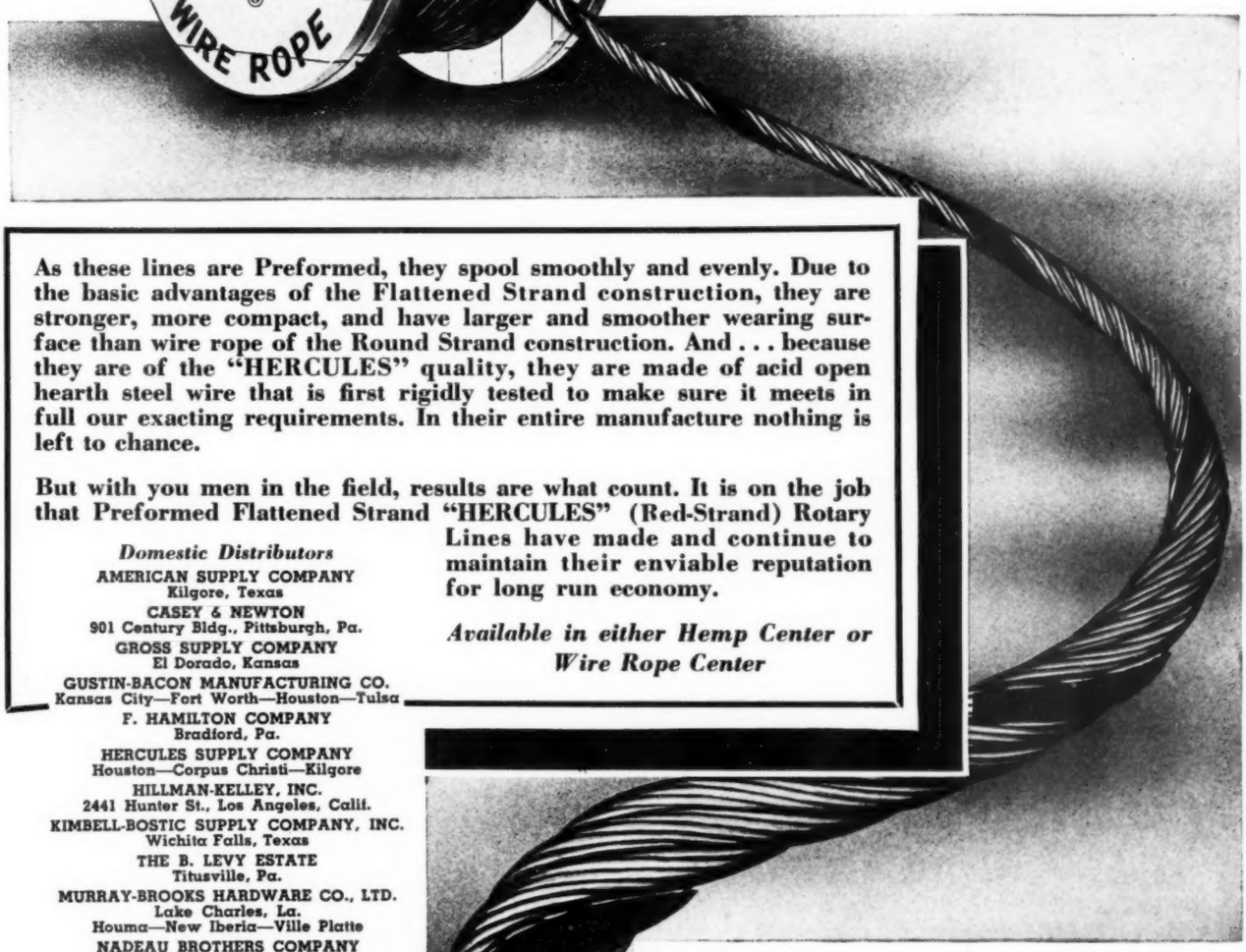

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Highlights IN OILDOM

May Make "Hot Oil" Law Permanent

Senator Connally of Texas has introduced legislation that would make permanent the Connally "hot oil" act. The new proposal has the support of Petroleum Coördinator Harold L. Ickes. Originally passed in 1935 for a two-year period, and since extended by subsequent acts of congress, the law prohibits the shipment in interstate commerce of petroleum products produced in violation of state regulations.

New Salt Water Order for East Texas

The Texas Railroad Commission, beginning January 1, will give an extra allowable of 1 bbl. of oil for each 50 bbl. of salt water injected in East Texas field wells. The step is being taken to encourage the building-up of pressure in the water-driven reservoir. The commission announced its order following a conference with Conservation Director E. L. DeGolyer of the Petroleum Coördinator's Office at Dallas, Texas.

The order provides that the additional allowable, allocated to the leases producing the water, shall be distributed by the commisison to the wells on the leases but not more than 6 bbl. a day will go to any one well. An 8-bbl. top allowable is permitted on the water produced from any one well. For example, on a well that provides 500 bbl. of injected water, the 1 to 50 rate would cease when 8 bbl. allowable had been reached at 400 bbl. This allowable then would be spread to other wells on the lease, no one well, however, obtaining more than 6 bbl. extra allowable per day.

Under the order a monthly statement concerning the leases involved in water disposal and figures on the amount of water injected are to be sent to the commission. The allowables are based on the amount of water returned the previous month. The well status reports are to be submitted every three months, these to show the results of tests made during the last 30 days of the period.

Salt water is defined as water from the Woodbine sand having a chloride concentration of more than 35,000 parts per million.

Operators who converted producing oil wells into injection wells under the March 29, 1940, order will continue to obtain that allowable plus the injection subsidy allowed by the latest order.

Hearings are required for completion and operation of salt water injection wells.

Wage-Hour Ruling

Judge Fred M. Raymond of the United States District Court at Grand Rapids, Michigan, in a recent decision upheld the contention of the Wage and Hour Division of the U. S. Department of Labor that an employer who either knows or has reason to believe the goods he produces will move in interstate commerce must comply with the provisions of the Fair Labor Standards Act in the production of such goods even though the goods are all sold by the producer within the state of production.

The decision was made in granting the Wage and Hour Division an injunction enjoining the Rex Oil and Gas Company of Muskegon, Michigan, from further violations of the Wage-Hour Law.

In his ruling Judge Raymond said:

"Notwithstanding the fact that the defendant sold within the State of Michigan all the oil which it produced, its employees were, during the period in question, engaged in the production of the goods for interstate commerce within the meaning of the Fair Labor Standards Act because at the time said oil was produced defendant knew or had reason to believe that substantial portions of said oil and the products refined therefrom would move in interstate commerce."

Another contention of the Wage and Hour Division also was upheld by Judge Raymond in the same case when he ruled that oil pumpers and roustabouts, if subject to the minimum wage and overtime provisions of the law at all, must be paid for all hours spent on the job when required or expected to be on or near the premises, whether actually performing manual duties or not.

Costs More to Find Oil, Survey Shows

The ability of the United States petroleum industry to supply the crude oil needed for the defense program and for the usual domestic markets—industrial and private consumers—depends upon the finding of new fields.

Because of increased costs of acquiring and finding the new reserves and of producing from those now existing, there is not sufficient incentive today at present prices for crude oil to maintain the needed amount of exploratory work, it is pointed out in a comprehensive survey on crude petroleum costs made by the Independent Petroleum Association of America. The report has been submitted to Price Administrator Leon Henderson and Petroleum Coördinator Harold L. Ickes.

The report is a detailed study of the cost of finding, developing, and producing crude oil properties during the years 1937-41. It shows that the average investment required for an oil well has increased from $28,000 in 1937 to almost $41,000 in 1941.

On a per-barrel basis, the cost of finding, developing, and producing crude oil has increased 35 cents per bbl. since 1937. The present average price of crude oil paid to the producers is 6 cents less than it was in 1937.

Operating costs of small wells of settled production—pumping wells that make but a few barrels daily—were found to have increased about 30 cents per bbl. in the period covered by the survey.

Most of the discoveries of new fields are made by the smaller units in the industry. In 1940, approximately 75 percent of the new fields were found by independent operators. Their ability to drill "wildcat" or exploratory wells depends upon the incentive of a price for crude oil sufficient to return their investment; and, as a large percentage of these "wildcat" wells are failures, the cost of discovery of a new field is by no means represented by the cost of any pioneer well in a new area.

A new factor has recently come into the calculations on producing oil. That is the salvage value of the equipment used in producing the smaller wells. It is now profitable to abandon what formerly was considered a good well. The steel and other materials can be sold today for more than the operator can expect to realize from the sale of oil for a long time ahead. Concerning these smaller wells, the report of the Independent Petroleum Association says:

"Material costs have doubled since 1937. Fixed price ceilings in major metal markets have not protected the stripper operator whose materials now cost 14.95 cents per bbl. more than in 1937. New material is difficult to obtain and secondhand material is selling at premiums over the quoted price for new materials. For example, casing which formerly cost 45 cents a lb. is now selling in the secondhand market at over $1.00 a lb."

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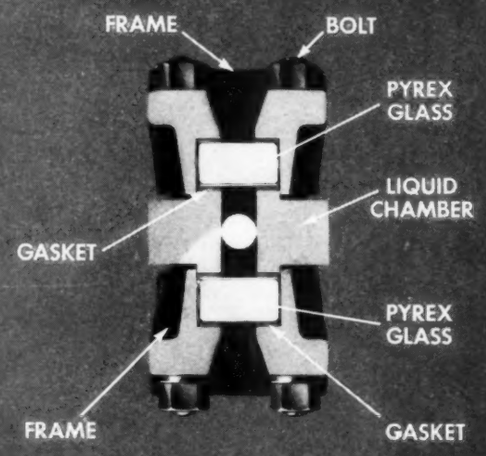

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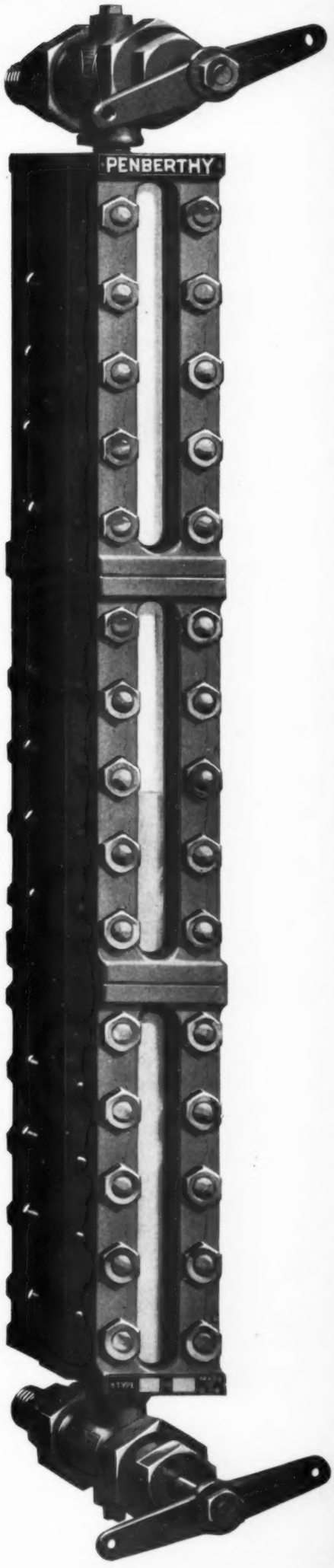

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Western Division, 71.9 Percent Central Division, 107.8 Percent Eastern Division, 94.6 Percent

DEFENSE PETROLEUM Coördinator, Harold L. Ickes, has announced top priority rating for five more plants to manufacture 100-octane gasoline or its components.

The addition of the five new projects given ratings brings the total number of such plants now under construction to 25, Ickes said. In addition to the five plants, high priority ratings have been obtained for materials for construction of plants and additional units for the manufacture of aviation and other special lubricating oils.

From 10 to 14 months will be required to finish the new plants. Among the total of plants the five new ones include the following: The Warren Petroleum Corporation, Tulsa, Oklahoma, *iso*butane; Standard Oil Company of Louisiana, New Orleans, catalytic cracking plant; The Gulf Oil Corporation, Port Arthur, Texas, 100-octane gasoline, and the Sinclair Refining Company, Houston, Texas, 100-octane gasoline.

Plants to manufacture aviation and other special lubricating oils are: The Shell Oil Company, Inc., Houston, Texas, pilot plant; The Sinclair Refining Company, Houston, Texas, aviation lubes; The Sun Oil Company, Marcus Hook, Pennsylvania, aviation and special lubes, and Standard Oil Company of California, Richmond, aviation and special lubes.

A high priority rating also has been obtained for material for a plant for the Panhandle Power and Light Company, Borger, Texas, for a boiler plant to supply power to a new 100-octane gasoline plant.

The Warren Petroleum Corporation of Tulsa will construct two natural gasoline plants, one in the Cumberland pool of Bryan and Marshall counties at Madill, Oklahoma, and the other in the New Harmony pool of White County, Illinois. The Madill plant will make 25,000 gal. per day of products when placed in operation January 1. The Illinois plant will make 160,000 gal. per day of products, including *iso*butane. This plant is to be part of a repressuring product planned by Superior Oil Company of California, Tide Water Associated Oil Company, Tulsa, Sun Oil Company of Philadelphia, and Continental Oil Company, Ponca City, Oklahoma.

The old plant of The Panama Refining Company at Stephens, Arkansas, is being rebuilt to manufacture asphalt and other products from a crude oil produced in that area. On completion, the plant will process 1500 bbl. of oil per day, according to a statement by an official.

Contract has been awarded by The Humble Oil and Refining Company for construction of a cycling plant to cost $3,000,000 to the Stearns-Roger Manufacturing Company of Denver, Colorado. Work is expected to begin immediately.

Located in the Katy gas pool of Waller County, Texas, the plant will process approximately 200,000,000 cu. ft. of gas per day. It will make in excess of 5000 bbl. of finished products per day. Gas from the plant will be returned to the producing formation.

The 40-acre site of the plant is about 4 miles north of Katy.

Injection of gas into the the formation initially will be into 2 wells, and later into an additional 4 wells. In addition to production from Humble wells, 11 other operators in the field have unitized to produce gas for the plant.

The Continental Oil Company plans a new $375,000 addition to its refinery at Lake Charles, Louisiana. This will allow the plant to step-up production of aviation gasoline. Announcement of the plan was made by Governor Sam Jones.

Application has been made by the company for a 10-year tax exemption for the addition, and will be placed before the State Board of Commerce and Industry.

Present investment in the Lake Charles plant by the company is estimated at $4,000,000. Addition of the new equipment will increase production of aviation gasoline from 18,000 bbl. to 24,000 bbl. per month. Also additional quantities of *iso*pentane will be made available to other plants for aviation gasoline.

Phillips Petroleum Company has been granted permission by the New Mexico Conservation Commission to operate a gasoline plant in the Vacuum field of Lea County.

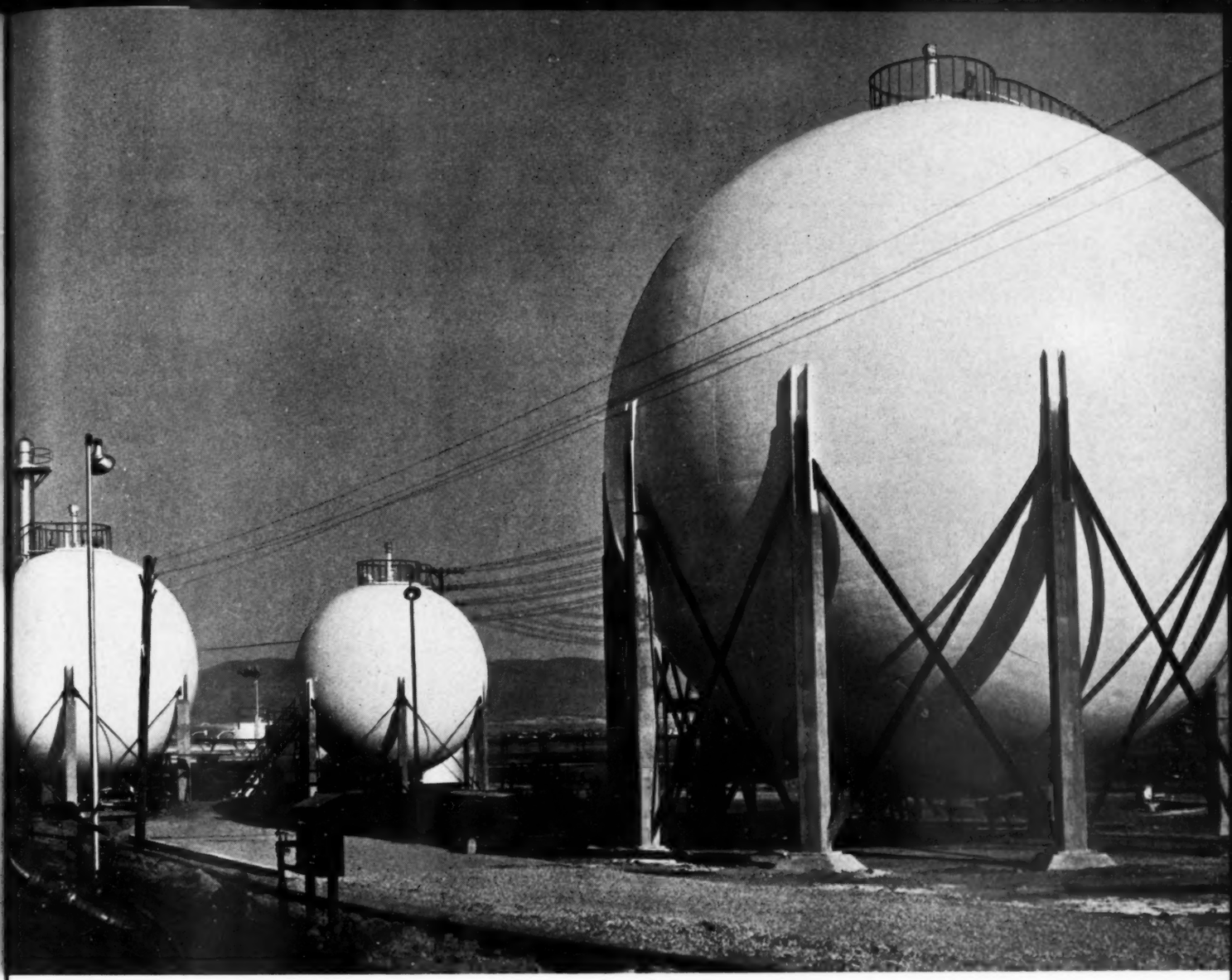
Construction of a plant having a capacity of 25,000 gal. of gasoline per day is planned by the company. Officials of the company have estimated that approximately 7,000,000 cu. ft. of gas will be necessary to produce that amount of gasoline.

Rebuilding of the Bradford Oil Refining Company plant at Foster Brook, suburb of Bradford, Pennsylvania, has begun by The Kendall Refining Company. The plant will begin operation January 1 and produce gasoline and other by-products from Pennsylvania grade crude oil.

Crude Runs to Stills, Gasoline, Gas and Fuel Oil Stocks
Week Ended November 29, 1941
A.P.I. Figures
(Figures in thousands of bbl. of 42 gal. each)

DISTRICT	Percent Potential Capacity Reporting	Daily Avg. Crude Runs to Stills	Percent Operated of Total Capacity Reporting	Total Motor Fuel Stocks	Total Gas and Fuel Oil Stocks
East Coast	100.0	653	97.0	19,435	34,631
Appalachian	83.8	143	102.9	3,447	1,110
Ind., Ill., Ky.	84.4	663	104.4	15,469	10,102
Okla., Kans., Mo.	80.7	298	89.5	7,858	4,255
Inland Texas	63.2	123	74.1	2,410	1,781
Texas Gulf	91.0	1,051	105.2	11,599	14,564
Louisiana Gulf	94.2	191	129.1	2,937	3,982
No. La. and Ark.	49.9	44	93.6	428	698
Rocky Mountain	50.1	46	67.6	1,134	491
California	90.9	517	72.3	15,458	75,648
Reported	86.4	3,729	95.1	80,175	147,262
Estimated Unreported	.....	386	.....	5,350	2,850
*EST'D TOTAL U. S. NOV. 29, 1941	.....	4,115	.....	(a)85,525	150,112
*EST'D TOTAL U. S. NOV. 22, 1941	.....	3,995	.....	84,579	150,378
U. S. B. of M. *NOV. 29, 1940	.....	**3,512	.....	79,495	150,591

*Estimated Bureau of Mines' basis.
**November, 1940, daily average.
(a) Finished 77,479,000 bbl.; Unfinished 8,046,000 bbl.



TAMING "WILD VOLATILES"

To prevent them from vanishing into thin air, "*wild volatiles*," including propanes, isobutanes and butanes, must be "*tamed*" — kept under close control at all times. Storing these highly volatile products, then, becomes of prime importance in securing maximum operating efficiency. One of the most practical, proved storage methods is the use of Hortonspheres—true spherical design steel pressure tanks.

Hortonspheres offer a positive means for preventing evaporation losses. As gas pressure can build up only in a vapor-tight vessel, the fact that pressure does exist is ample proof that no loss is occurring. In short, no loss can be experienced as long as venting does not take place.

Because of this pressure storage principle, Hortonspheres are highly effective in eliminating, or reducing materially, losses due to breathing, boiling and filling (particularly after the first filling.)

The above illustration is an example of the way in which Hortonspheres are serving the oil industry. Installed at the Avon, California, refinery of the Tide Water Associated Oil Company, these three units serve this company's modern alkylation plant. One sphere, a 2,000-bbl. unit designed for 60 lbs. per sq. inch working pressure, is used for the storage of butylenes. The second unit, of 2,500-bbls. capacity, stores isobutane at 75 lbs. pressure. The largest of the three, shown at the right, above, has a capacity of 12,000 bbls., and is used for the storage of normal butane at a working pressure of 50 lbs. per sq. inch.

CHICAGO BRIDGE & IRON COMPANY

BIRMINGHAM - CHICAGO - CLEVELAND - DETROIT - HOUSTON
LOS ANGELES - NEW YORK - PHILADELPHIA - SAN FRANCISCO
TULSA - WASHINGTON

HORTONSPHERES

MAJOR *Oil Field* ACTIVITIES

A NEW lime area about 2¾ miles north of the Grayburg pool in Eddy County, New Mexico, has been opened by the Sanders Brothers well Harry Leonard No.1. Location of the well is 1980 ft. from the south and 660 ft. from the west lines of section 2-18s-30e. The well was completed for a flow of 77 bbl. of 38.2-gravity oil per day, gauging through a 2-in. tubing. Gas flow measured almost 50,000 cu. ft. per day. Production was found at 2953-65 ft. and total depth is at 2982 ft.

R. D. Brown's Antell No. 1, 20-1s-11w, Gibson County, Indiana, swabbed 150 bbl. of oil in 10 hours from the McClosky lime at 2262 ft. The new McClosky lime pool discovered by the wildcat is approximately 5 miles west of Patoka, Illinois.

The Phillips Petroleum Company and others, Roy L. Fisher No. 1 Womack, 12-6n-6e, Catahoula Parish, Louisiana, flowed 15 bbl. of 37-gravity oil per hour through perforations at a depth of 5533-37 ft. The well opens a new pool in Louisiana, and is producing from the Wilcox formation.

A new Ellenburger, lower Ordovician, pool has been opened by Gulf Oil Corporation and L. H. Wentz, 4½ miles south of Girvin, in northeastern Pecos County, Texas.

The well, L. H. Miller et al. No. 2, 1980 ft. from the south and east lines of section 43, block 11, H&GN survey, is 8½ miles northwest of the Taylor Link Permian pool. Forty-six and one-half bbl. of 36.3-gravity crude oil was swabbed in 19 hours. An attempt to increase production to an estimated 25 bbl. of oil per day natural flow has caused operators to acidize the Ellenburger dolomite. The well is at a total depth of 4363 ft.

Stephens County, Oklahoma, has a new, shallow Arbuckle lime oil pool opened by Glen Grimes' Baker No. 1-B, SE NW NE, 35-2s-6w. Located about 2 miles south of a small pool, the well flowed 505 bbl. of oil, without water, and an unestimated quantity of gas in 5¾ hours from a total depth of 1838 ft.

Mississippi has a new oil pool opened by C. L. Morgan No. 1 Whitworth, in 4-11n-3e, about 1½ miles southeast of the 4-well Pickens pool in Madison County. A flow of 28 bbl. of fluid per hour, cutting some basic sediment and wash water, came from the well through tubing choke from 40 perforations opposite the Eutaw between 4824-33 ft. Tubing pressure was 140 lb. and casing pressure 250 lb.

Pryor and Lockhart and Wilton J. Coppinger Massey No. 1, CEL NE NW, 35-30-15, flowed wild to open a new oil pool in Barber County, Kansas. Flow from the well was at the rate of 25-30 bbl. of oil per hour after casing perforation in the Lansing-Kansas City lime from 4344-55 ft. Drilled originally to the Arbuckle lime, the well had a total depth of 4726 ft. only to find a dry zone. Location of the well is about 9 miles northwest of the Lake City pool and is Barber County's first Lansing-Kansas City lime production.

AVERAGE CRUDE OIL PRICES

California		Louisiana	
Kettleman Hills	$1.23-1.29	Rodessa	.88-1.20
Playa Del Rey	.80- .87	Gulf Coast	.94-1.48
Coalinga	.73-1.13	North Louisiana	1.20-1.30
Wilmington	.68-1.24		
Montana	1.00-1.15	Illinois	1.22-1.37
Wyoming	.40-1.30	Kentucky	1.32-1.43
Colorado	.95- .97	Indiana	1.22
New Mexico	.70-1.12	Ohio	
Texas		Lima	1.17
North Central	.78-1.18	Michigan	1.11-1.45
Panhandle	.70-1.12	Pennsylvania	
West Texas	.70-1.12	Bradford	2.75
Gulf Coast	.93-1.48	Southwest	2.40
Darst Creek	1.14	Eureka	2.34
East Texas	.80-1.27	Buckeye	2.30
Talco	.79	Corning	1.31
Kansas	.75-1.25		
Oklahoma	.75-1.25		
Arkansas	.83-1.15		

DAILY AVERAGE CRUDE OIL PRODUCTION

Data Supplied by A.P.I.

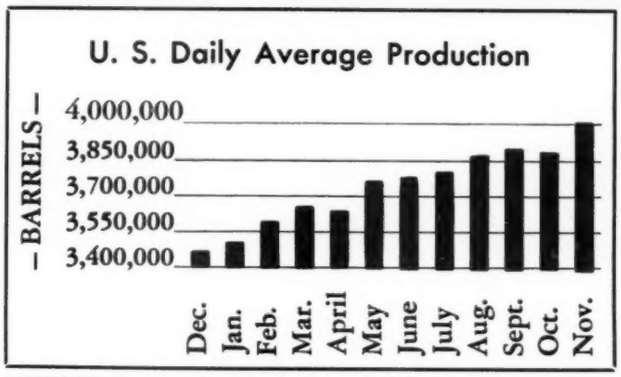
(Figures in bbl. of 42 gal. each)

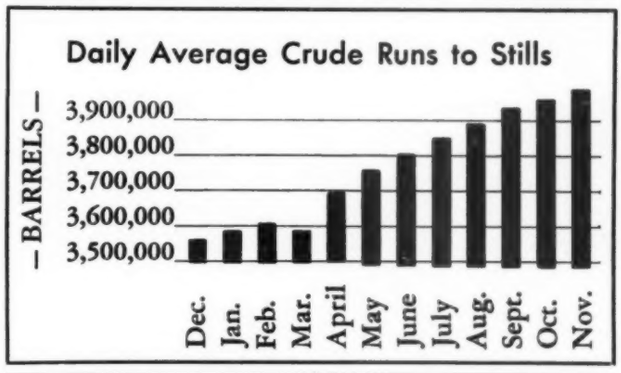
	[1]B. of M. Calculated Requirements (November)	Week Ended Nov. 29, 1941	Week Ended Nov. 1, 1941	Week Ended Nov. 30, 1940
Oklahoma	469,400	[2]425,100	436,400	403,550
Kansas	253,500	[2]249,200	237,350	196,650
Nebraska	6,200	[2] 5,800	6,450	2,550
Panhandle Texas	.....	85,100	80,100	50,500
North Texas	.....	107,050	105,600	106,250
West Central Texas	.....	30,950	31,350	28,150
West Texas	.....	286,500	285,600	178,800
East Central Texas	.....	86,100	85,850	72,850
East Texas	.....	369,500	369,700	298,700
Southwest Texas	.....	216,250	220,000	159,800
Coastal Texas	.....	291,200	291,750	194,300
TOTAL TEXAS	1,454,700	1,472,650	1,469,950	1,089,350
North Louisiana	.....	81,600	80,750	66,500
Coastal Louisiana	.....	266,850	261,400	219,850
TOTAL LA.	333,200	348,450	342,150	286,350
Arkansas	76,500	74,050	72,400	69,400
Mississippi	55,100	[2] 74,450	63,300	16,000
Illinois	408,100	400,300	419,800	327,400
Indiana	20,500	[2] 18,400	18,000	20,550
Eastern (not incl. Ill. & Ind.)	94,300	96,250	99,450	89,250
Michigan	47,400	56,950	57,950	46,350
Wyoming	83,400	82,050	79,700	72,650
Montana	20,600	21,400	20,000	17,800
Colorado	5,200	5,350	5,750	3,500
New Mexico	115,200	117,800	116,450	101,100
TOTAL EAST OF CALIF.	3,443,300	3,448,200	3,445,100	2,742,450
California	626,700	638,400	626,100	592,600
TOTAL U. S.	4,070,000	4,086,600	4,071,200	3,335,050

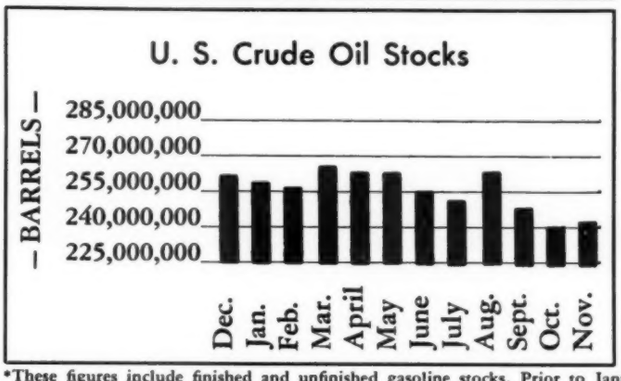
[1]These are Bureau of Mines' calculations of the requirements of domestic crude oil based upon certain premises outlined in its detailed forecast for the month of November. As requirements may be supplied either from stocks, or from new production, contemplated withdrawals from crude oil inventories must be deducted from the Bureau's estimated requirements to determine the amount of new crude to be produced.

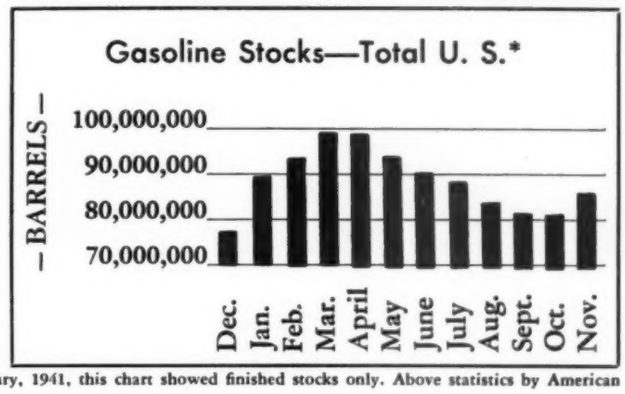
[2]Oklahoma, Kansas, Nebraska, Mississippi, and Indiana figures are for week ended 7 a. m., November 26th.

PETROLEUM *Statistics* AND FIELD *Operations*









*These figures include finished and unfinished gasoline stocks. Prior to January, 1941, this chart showed finished stocks only. Above statistics by American Petroleum Institute.

Summarized Operations in Active Fields for November, 1941

Fields	Completions	Producers	Rigs	Drilling Wells	Depth of Production	No. Casing Strings	Gravity of Oil	Type of Tool Used
TEXAS								
East Texas	84	68	14	32	3500-3700	2	40	Rotary
Gaines County	11	10	4	12	4400-5584	2	22-35	Rotary
Hockley County	42	42	7	14	4800-6850	2	20-30	Rotary
Ector County	21	21	14	21	3675-4377	2 or 3	32-36	Rotary
Panhandle	68	66	10	27	1700-3900	2	40	Rot.-Cab.
Nueces County	26	22	8	20	3922-5878	2 or 3	21-54	Rotary
K. M. A. Field	24	23	7	15	3730-3935	2	42-43	Rot.-Cab.
Hawkins Field	26	25	7	23	4495-4912	2	19-29	Rotary
OKLAHOMA								
Okfuskee County	22	17	8	14	2150-4125	2 or 3	38	Rotary
KANSAS								
Russell County	28	23	6	24	2926-3435	2 and 5	32-37	Rot.-Cab.
Rice County	16	12	9	15	3222-4085	2 and 5	42-48	Rot.-Cab.
Barton County	25	18	8	22	3290-3518	2	39-42	Rot.-Cab.
ILLINOIS								
Central Illinois	337	266	365	180	1425-4100	2	36-38	Rot.-Cab.
NEW MEXICO								
Lea County	16	11	8	18	3150-4030	2	30-34	Rot.-Cab.
CALIFORNIA								
Kern County	30	27	14	28	1840-11,450	3 or 4	14-30	Rotary
Wilmington	18	18	6	13	3500-4000	2 and 3	18-20	Rotary

Field Activities by States for November, 1941

State	Completions		Producers		Locations		Rigs		Drilling Wells		Production, 1940 (In Barrels)
	November	October	November	October	November	October	November	October	November	October	
Arkansas	17	38	13	17	14	19	10	10	13	22	25,699,000
California	101	133	92	116	57	66	78	88	80	93	224,029,000
Colorado	3	1	2	....	1	3	3	2	1	1	1,369,788
Illinois	337	490	266	394	406	501	365	390	180	175	146,572,938
Indiana	46	53	26	32	55	70	20	30	53	64	4,946,384
Kansas	132	240	86	173	190	260	18	23	140	160	65,602,452
Kentucky	34	27	20	11	39	45	8	8	25	27	5,282,335
Louisiana	136	192	91	122	110	181	52	60	195	218	103,738,728
Michigan	86	95	67	61	94	135	25	23	76	85	19,768,984
Mississippi	8	44	6	35	....	....	....	....	....	....	4,313,158
Montana	29	38	22	29	19	23	10	8	15	19	6,663,872
Nebraska	9	12	5	10	8	6	6	4	6	8	267,533
New Mexico	43	47	35	41	45	43	18	20	39	41	38,893,898
New York	135*	119*	65*	119*	....	....	....	....	....	....	4,240,441
Ohio	162	200	121	156	....	....	....	....	....	....	3,132,280
Oklahoma	126	224	84	163	186	284	71	64	110	103	152,516,049
Pennsylvania	154*	315*	147*	303*	....	....	....	....	....	....	17,987,217
Texas	903	1103	633	815	1040	1129	800	793	1215	1363	490,101,261
West Virginia	72	98	66	76	41	47	36	20	104	108	3,586,653
Wyoming	9	12	8	10	11	14	5	7	7	13	25,863,538
Total	2406	3481	1855	2683	2316	2826	1525	1550	2259	2500	1,344,576,159

*Includes water-intake and pressure wells.

MAJOR *Pipe Line* ACTIVITIES

THE Lone Star Gas Company has announced the beginning of construction of a 12-in. pipe line into the Sewell field of Young County, Texas, and plans for laying a 6-in. line into the Pottsville gas area of Hamilton County.

The Sewell line will be laid from the company's compressor station at Brad in Palo Pinto County 27 miles north to Sewell. It will have a capacity of 25,000,000 cu. ft. per day. The line will cross the Brazos River at a point just below Possum Kingdom Dam. Pipe used in laying the line is that salvaged from a former line extending from San Angelo to the Big Lake field.

On completion of the Sewell line, crews will start laying the Pottsville line that will extend 15 miles to a point north of Hamilton, tying in with the company's system.

Dedication of the 456-mile gasoline pipe line of the Southeastern Pipe Line Company, which required a special act of congress before it could be completed through a portion of Georgia, will take place in Atlanta, Georgia, December 19.

Senator Walter F. George, Georgia, and Representative William P. Cole, Jr., Maryland, two of the Nation's leaders, are scheduled to speak at the ceremonies. Numerous other prominent men will also be on the program.

A common carrier, the pipe line will take gasoline that comes by tanker to Port St. Joe, Florida, and move it to Bainbridge, Albany, Americus, Mason, Griffin, Atlanta, and Rome, Georgia, and to Chattanooga, Tennessee.

Twenty-two thousand tons of oil tankers or approximately 2.2 percent of the tankers now in use in American waters will be replaced by the line. As a short cut the line will reduce tanker mileage in some cases by almost two-thirds and disposes of the necessity of entering the Atlantic ocean, which is important in time of war.

Capacity of the line is estimated at 30,000 bbl. of gasoline per day. A report from the contracting company, Williams Brothers Corporation, Tulsa, Oklahoma, stated that more than 31,000 tons of 8- and 6-in. steel pipe, or more than 60,000 individual pieces of pipe in 40-ft. lengths, were hauled from supply bases and strung along the right-of-way. The ditch for the line was 2,418,000 ft. in length with more than 1200 men employed on construction of the line at one time.

Construction of a 10-in. pipe line from the Tinsley pool of Mississippi to Baton Rouge, Louisiana, will begin within 60 to 90 days, according to an announcement made by the Standard Oil Company of New Jersey. A final decision has not yet been made as to whether the line will be constructed and operated by the Oklahoma Pipe Line Company, Tulsa, Oklahoma, or some other affiliate of the Jersey company. The terminus of the Kansas-Oklahoma pipe line system of Oklahoma Pipe Line Company is at Baton Rouge.

Completion of 3 gaps in an 18-in. line to parallel its present line from Monroe, Louisiana, to Memphis, Tennessee, has been announced by the Memphis Natural Gas Company. Estimated cost of the lines will be $1,200,000. Due to the fact that gas production in the Monroe and Richland fields has been greatly reduced, it is probable that purchases will be made from trunk lines that deliver gas from the Shreveport, Louisiana, district to Monroe.

John M. Hall, American oil company engineer in Chungking, China, has disclosed plans for the laying of a pipe line along the 700-mile Burma Road to supply gasoline for China's growing war machine.

The construction of 12-in. loops for its Wyoming-Kansas-Missouri trunk pipe line have been announced by The Stanolind Pipe Line Company to begin immediately.

Two loops, an aggregate of 54 miles of line, will increase the flow of crude oil from pools in the Rocky Mountain fields to the Mid-Continent and Great Lake refinery areas.

Construction of the first loop will be about 40 miles southeast of Kansas City, Kansas, and west of Freeman. The second loop is at Topeka, Kansas. One loop is to be 25 miles in length and the other about 19 miles.

The Sinclair Refining Company has begun construction on the first section of the 340-mile, 6-in. pipe line to transport refined products from Marcus Hook, Pennsylvania, to Pittsburgh, Pennsylvania. First construction operations have begun near Lancaster and Harrisburg, Pennsylvania, and several other points.

The first section to be laid will be 170 miles in length, contract for which has been let to Sheehan Pipe Line Construction Company and O. C. Whitaker Company.

A charter in Pennsylvania had been applied for by Sinclair for the Union Pipe Line Company preparatory to obtaining permission for the project.

Seventy-two miles of 8-in. pipe line in 7 loops is being added by the Phillips Petroleum Company to the trunk line owned by the company in Missouri. This line is part of the system for transportation of finished products from Borger, Texas, to Chicago, Illinois. Construction of the line began in the early part of December.

The first line built by the Cities Service Gas Company by contract in 10 years is the construction of more than 52 miles of 16-in. gas pipe line from Cement to Oklahoma City, Oklahoma. The line is being laid by the Midwestern Engineering and Construction Company and will be electric welded.

Work is now in progress on the construction of 101 miles of 8-in. crude oil pipe line contracted for by Black Construction Company. The line will have its beginning in the recently opened field at Apache, Oklahoma, and will extend to Seminole, Oklahoma. Approximately 30 miles of pipe have been delivered with another 30 miles due in the immediate future. The line will be completed February 1.

The 13-loop program of the Gulf Refining Company, Tulsa, Oklahoma, is completed except for one loop, which is soon to be finished. Two hundred and two miles of 10-in. loops between Glennpool, Oklahoma, and Dublin, Indiana, constituted the program.

Unfinished is the loop between Steelville Station, Missouri, and the Mississippi River, which is 19 miles in length. Muddy ground was the reason given for the delay on the loop; however, construction is expected to be completed this month.

To obtain the increased capacity of the line due to the loops, the company will complete the pumping station now under construction at State Line, Indiana. This station will be equipped with a 350-hp. Diesel engine, driving a centrifugal pump that will increase the line's capacity from 3000 to 4000 bbl. for a total of nearly 30,000 bbl.

Further increase of the line's capacity between Dublin and Cincinnati, Ohio, from 3000 to 4000 bbl. was made by looping with 20 miles of 8-in.

THE Petroleum Engineer

DECEMBER, 1941

The Thermal Properties of a Wet Gas

Exclusive

☆ Enthalpy-entropy and temperature-entropy diagrams for wet gases, such as condensate, aid in accurate calculations involving thermal properties

by George Granger Brown
Professor of Chemical Engineering, University of Michigan
and
Fred Kurata

IN AN article appearing in the April, 1941, issue of *The Petroleum Engineer*, page 34, methods were developed and demonstrated for computing the thermal properties, including an enthalpy-entropy diagram for dry natural gas. Examples were given showing the use of such a diagram in computing the drop in temperature accompanying a free expansion, the horsepower required for compression, and the heat to be extracted to obtain the desired temperature. In the present article it is planned to demonstrate how the thermal properties of the lighter hydrocarbons may be combined with the equilibrium volatility constants to construct a similar enthalpy-entropy diagram, or a temperature-entropy diagram, for a wet gas or effluent from a producing well forming a concentrate upon reduction of pressure.

In preparing the diagram for the dry gas, the gas at 32°F. and 1 atmosphere pressure was used as the reference state of zero enthalpy and zero entropy. In the preparation of the present chart for a wet gas the reference state will be liquid at 32°F. and 1 atmosphere pres-

GEO. GRANGER BROWN

graduated with a bachelor's degree in chemical engineering from New York University in 1917—Served with the Aluminum Company of America, the Chemical Warfare Service at Washington, D. C., the Union Special Machine Company, and Youngstown Sheet and Tube Company—In 1920 joined the staff of the Department of Chemical Engineering, University of Michigan—Received doctor's degree in 1924—The professional degree of chemical engineer was granted by New York University in 1925.

FRED KURATA

received bachelor of science degree from California Institute of Technology in June, 1934—M.S.E. in chemical engineering from University of Michigan in February, 1939—Ph.D. in chemical engineering from University of Michigan in June, 1941—At present he is working on a National Defense research project under Dr. Brown—After obtaining his B.S. degree he worked as a chemist in a California refinery for one and a half years.

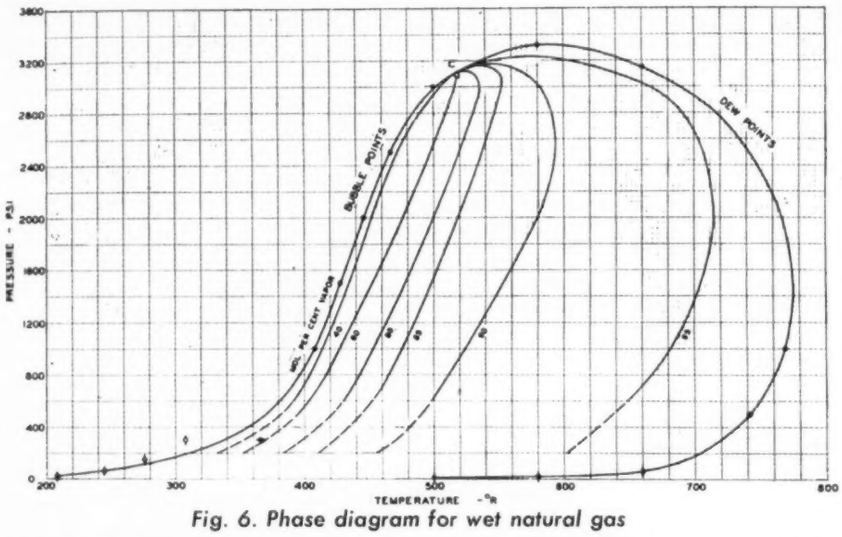


Fig. 6. Phase diagram for wet natural gas

sure. It is true that the material does not exist entirely in the liquid phase under these conditions, but this is immaterial as the reference state is simply an arbitrary condition chosen for purposes of computation.

Roland, Smith, and Kaveler[4] have determined experimentally the values for the equilibrium constants at 40°, 120°, and 200°F. for a mixture having the composition given in Table 2. From these data cross plots were prepared giving the values for the equilibrium volatility constants as functions of temperature for lines of constant pressure, so that values could be easily determined for any desired pressure and temperature. Because these charts can easily be prepared from the original data[4] and are of no direct utility except for the particular gas composition given in Table 2, these charts are not reproduced herein.

TABLE 2
Composition of wet natural gas used by Roland, Smith, and Kaveler[4]

Compound	*Mol, percent*
Methane	86.27
Ethane	3.38
Propane	2.33
Butanes	2.07
Pentanes	0.69
Hexanes	0.90
Heptanes +	4.36
Pseudo-critical temperature	408.5° absolute
Pseudo-critical pressure	651.1 lb. per sq. in. absolute
True critical temperature	518° absolute
True critical pressure	3090 lb. per sq. in. absolute

Using these equilibrium constants the bubble-point curve of the entire mixture of Table 2 was computed for the temperatures given in Table 3, by assuming a pressure to determine the value for the volatility constant and multiplying the mole fraction given in Table 2 by the corresponding value of the equilibrium constant. The summation of these products equals one (unity) when the assumed pressure is the bubble-point pressure for the chosen temperature. This procedure has already been explained in connection with the calculation of the temperature in the reboiler, equation (35), appearing in the June, 1940, issue of *The Petroleum Engineer*, page 55.

TABLE 3
Computed bubble points and dew points of the mixture of Table 2

Bubble point temperatures, °F.	*Pressure, lb. per sq. in. abs.*
—256	14.7
—215	60
—184	150
—123	300
— 50	1000
— 15	2000
32	2940
40	3000
58	3090*
Dew point temperatures, °F.	*Pressure, lb. per sq. in. abs.*
120	3300
200	3150
282	500
200	62
120	17
40	2.3

*Critical point.

The dew-point curve was determined in a similar manner by dividing the mole fraction of each component as given in Table 2 by the value for the equilibrium volatility constant at the assumed pressure. The sum of these quotients equals 1 when the assumed pressure used in determining the value for the equilibrium constant is the correct dew-point pressure for the chosen temperature. This procedure has been previously outlined in connection with the computation of the dew-point of the distillate gas at the top of a fractionating column in connection with equation (34) appearing in the May, 1940, issue of *The Petroleum Engineer*, page 28.

The results of these calculations of bubble-points and dew-points are plotted in Fig. 6 as the open circles. At pressures below 400 lb. per sq. in. absolute, it was necessary to extrapolate these experimental values for the equilibrium constants. The ideal equilibrium constants given in Fig. 13 in the June, 1940, issue of *The Petroleum Engineer*, pages 56, 57, 58, and 60, were used for this purpose. The points so calculated are indicated by a circle with a vertical line through the center. At the temperature from 500°R. to about 600°R. on the dew-point curve the ideal equilibrium constants could be determined directly from these figures in the June, 1940, issue. For purposes of comparison the bubble-point was computed using the vapor pressure of the pure hydrocarbon and Raoult's law at the pressure of 300 lb. per sq. in. This point is indicated as a circle with a horizontal line through it.

The bubble-point line and the dew-point line were then drawn through the points to indicate the boundaries of the two-phase region as shown in Fig. 6.

The critical point for the mixture of Table 2 was computed (by a method not yet published) and located at the point C, 58°F. and 3090 lb. per sq. in. absolute.

The lines showing the mole percent vapor within the envelope of Fig. 6 were drawn through points computed by the method described by Katz and Brown[5] using their equation (12):

$$\frac{V}{F} = \sum \frac{KZ}{K + L/V} \quad . \quad . \quad (27)$$

in which

V = total moles of vapor
F = total moles of feed or total material
L = total moles of liquid
Z = mole fraction of the hydrocarbon in the feed
K = equilibrium constant at the temperature and pressure of the particular hydrocarbon, in this case taken from the experimental values of Roland, Smith, and Kaveler.[4]

The enthalpy of the saturated liquid was computed at atmospheric pressure by use of the enthalpy data of the individual hydrocarbons as plotted in Fig. 7. The values read from this chart, applicable to atmospheric or zero pressure, are multiplied by the mole fraction of each component to determine the enthalpy of 1 lb. mole of the liquid

[4]Roland, Smith, and Kaveler, *Oil and Gas Journal*, Vol. 39, No. 46, p. 128 (March 27, 1941).

[5]Katz and Brown, *Industrial and Engineering Chemistry*, Vol. 25, No. 12, p. 1373, Dec., 1933.

mixture at atmospheric pressure. The enthalpy so computed for atmospheric pressure was then corrected to the pressure corresponding to the bubble-point curve at the corresponding temperature by means of the following equation:

$$\Delta H = \int \left[V - T\left(\frac{\partial V}{\partial T}\right)_P \right] dP \quad (1)$$

The values for the volume V, and the rate of change of volume with temperature at constant pressure were determined from Fig. 8.

The entropy of the saturated liquid was computed from the heat capacity relationship of Fig. 9 using the following equation:

$$\Delta S = \int C_p \, d\ln T \quad . \quad . \quad . \quad . \quad (25)$$

Equation (25) was used to compute the entropy as a function of temperature at atmospheric pressure. The entropy so computed was then corrected to the pressure corresponding to that of the bubble-point curve as shown in Fig. 6 by means of the following equation:

$$\Delta S_T = \int -\left(\frac{\partial V}{\partial T}\right)_P dP \quad . \quad (28)$$

The rate of increase of volume with temperature at constant pressure was determined as before from the data of Fig. 8. These computations are outlined in Example 4.

Example 4

Computation of enthalpy and entropy of the mixture at 58°F. and 3090 lb. per sq. in. abs.

Enthalpy

From Fig. 7, the relative enthalpy, H, of the liquid mixture at 58°F. and atmospheric pressure is 445 B.t.u. per lb. mol.

The increase in enthalpy due to the increase in pressure from atmospheric to 3090 lb. per sq. in. abs. is:

$$\Delta H = \int_{14.7}^{3090} \left[V - T\left(\frac{\partial V}{\partial T}\right)_P \right] dP$$

$$= -235 \text{ B.t.u. per lb. mol}$$

Therefore, H at 58°F. and 3090 lb. per sq. in. abs. is:

$H = 445 - 235 = 210$ B.t.u. per lb. mol

Entropy

From Fig. 9, the average C_p for the mixture between 32°F. and 58°F. at atmospheric pressure is 17.12 B.t.u. per lb. mol per °F. Therefore, the entropy, S, at 58°F. and 1 atmosphere referred to 32°F. is:

$$17.12 \ln \frac{518}{492} = 0.900 \text{ B.t.u. per lb. mol per } ^\circ R.$$

The increase in entropy of the mixture due to the increase in pressure from atmospheric to 3090 lb. per sq. in. is:

$$\Delta S = -\int_{14.7}^{3090} \left(\frac{\partial V}{\partial T}\right)_P dP = -1.4 \text{ B.t.u.}$$

per lb. mol per °R.

Therefore, the relative entropy at 58°F. and 3090 lb. per sq. in. is 0.900 — 1.4 = —0.500 B.t.u. per lb. mol per °R.

In this manner the enthalpy and the entropy for the saturated mixture were determined for all points on the bubble point curve given in Table 3 up to that of the critical point.

At the critical point the properties of the liquid and vapor are identical, and the entropy of the vapor and the enthalpy of the vapor are identical with the corresponding properties of the saturated liquid.

Using the entropy and the enthalpy of the critical point as a starting point, the entropy and enthalpy of the saturated vapor were computed for the conditions of temperature and pressure indicated along the dew-point line in Fig. 6 by a similar procedure using Figs. 2, 3, and 4 (April, 1941, issue, *The Petroleum Engineer*, pages 38 and 40) as outlined in Example 5.

Fig. 7. Enthalpy of hydrocarbon liquids

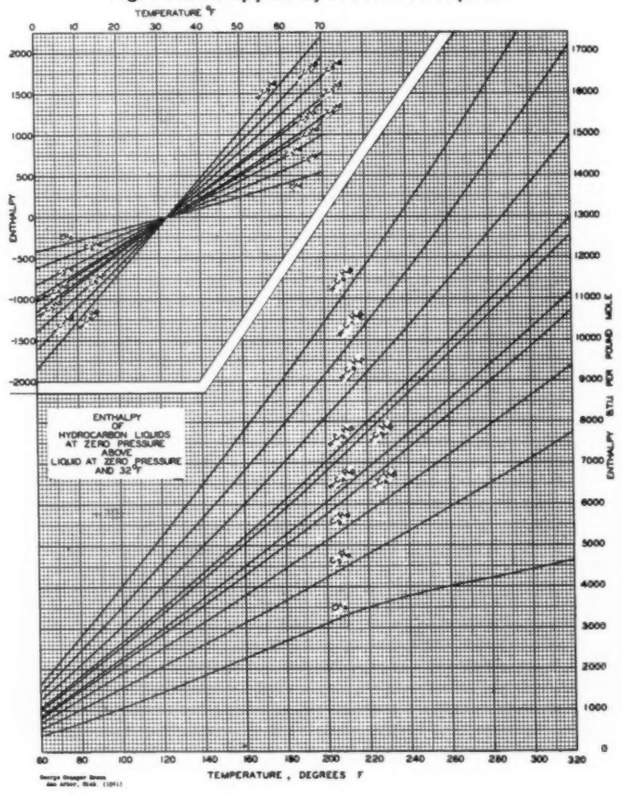
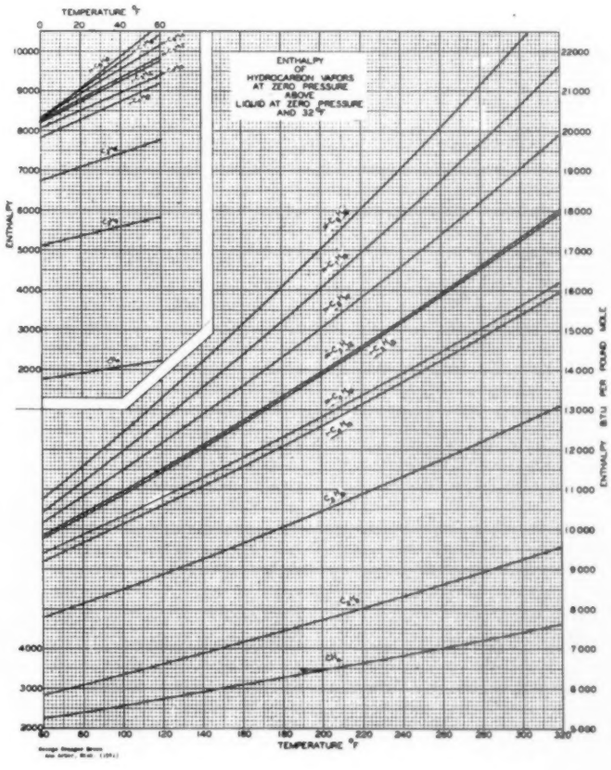

TEMPERATURE °F
ENTHALPY
ENTHALPY OF HYDROCARBON LIQUIDS AT ZERO PRESSURE ABOVE LIQUID AT ZERO PRESSURE AND 32°F
ENTHALPY BTU PER POUND MOLE
TEMPERATURE, DEGREES F

Fig. 10. Enthalpy of hydrocarbon vapors


TEMPERATURE °F
ENTHALPY
ENTHALPY OF HYDROCARBON VAPORS AT ZERO PRESSURE ABOVE LIQUID AT ZERO PRESSURE AND 32°F
ENTHALPY BTU PER POUND MOLE
TEMPERATURE °F

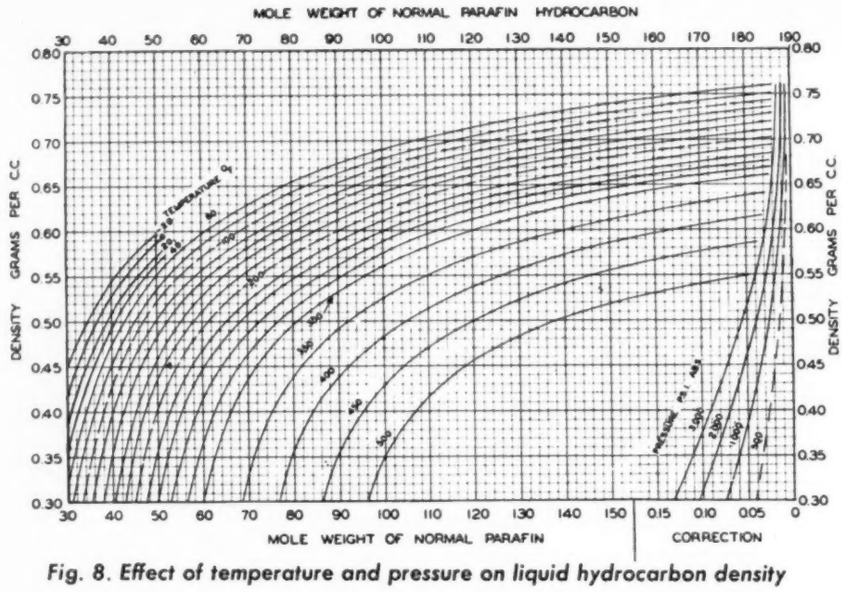


Fig. 8. Effect of temperature and pressure on liquid hydrocarbon density

Example 5

Computation of relative enthalpy and entropy at 120°F. and 3300 lb. per sq. in.

Enthalpy

The enthalpy of the mixture as a vapor at 120°F. and atmospheric pressure referred to liquid at 32°F. is computed by Fig. 10 and the mol fraction of Table 2 as 3770 B.t.u. per lb. mol.

The pseudo-reduced temperature, T_R, and pressure, P_R, at 120°F. and 3300 lb. per sq. in. abs. are:

$$T_R = \frac{580}{408.5} = 1.42$$

$$P_R = \frac{3300}{651.1} = 5.07$$

From Fig. 2, and these reduced properties, the increase in enthalpy caused by the increase in pressure from zero to 3300 lb. per sq. in. at 580° abs. is obtained as follows:

$$\frac{-\Delta H}{T} = 3.37$$

$\Delta H = -3.37 \times 580 = -1955$ B.t.u. per lb. mol.

For this calculation it may be assumed that the enthalpy at atmospheric pressure is the same as at zero pressure. Therefore, the relative enthalpy at 120°F. and 3300 lb. per sq. in. is:

3770 — 1955 = 1815 B.t.u. per lb. mol.

Entropy

The entropy of the mixture at the critical point, 58°F. and 3090 lb. per sq. in. is —0.5 B.t.u. per lb. mol per ° abs. as computed in Example 4. The corresponding pseudo-reduced temperatures and pressures are:

58°F., $T_R = \frac{518}{408.5} = 1.27$

120°F., $T_R = \frac{580}{408.5} = 1.42$

3090 lb. per sq. in., $P_R = \frac{3090}{651.1} = 4.75$

3300 lb. per sq. in., $P_R = \frac{3300}{651.1} = 5.07$

The increase in entropy, ΔS, between 3090 lb. per sq. in. and atmospheric pressure at 58°F. from Fig. 3 is +13.51.

The increase in entropy, ΔS, at one atmosphere between 58°F. and 120°F. is 1.1 by Fig. 4 and equation (25).

The increase in entropy, ΔS, at 120°F. between one atmosphere and 3300 lb. per sq. in. is —13.2 (from Fig. 3).

Therefore, the relative entropy at 120°F. and 3300 lb. per sq. in. is:

—0.5 + 13.51 + 1.1 — 13.2 = 0.91 B.t.u. per lb. mol per ° abs.

These computed values given in Table 4 are plotted on the enthalpy-entropy diagram, Fig. 11, locating the lines for the saturated liquid and saturated vapor.

In the one-phase region outside this envelope on the enthalpy-entropy diagram, the values are computed in the manner outlined above, or as in the April, 1941, issue of *The Petroleum Engineer*, using the critical point as the beginning point inasmuch as the critical values have been computed (following Example 5 above the critical temperature and Example 4 at lower temperatures).

Points computed in this manner were plotted in the enthalpy-entropy diagram, Fig. 11, and the lines of constant pressure were drawn in as shown.

For computing the lines within the two-phase region, the entropy and enthalpy of the liquid and of the vapor at each point were computed as for an individual mixture in the same manner as has been outlined above for the total mixture. For example, the mixture of liquid and vapor existing at 120°F. temperature and 2000 lb. per sq. in. pressure was computed as indicated in Example 6.

Example 6

Computation of relative enthalpy and entropy at 120°F. and 2000 lb. per sq. in.

At 120°F. and 2000 lb. per sq. in. the mixture of Table 2 exists in two phases, computed by equation (27), as shown in Table 5.

TABLE 4

Relative values of enthalpy and entropy along the phase boundary of the mixture of Table 2

Bubble point temperature, °F.	*Bubble point pressure, lb. per sq. in.*	*H B.t.u. per lb. mol*	*S B.t.u. per lb. mol per °abs.*
—256	14.7	—4950	—15.11
—215	60	—4248	—11-94
—184	150	—3714	— 9.97
—123	300	—2652	— 6.56
— 50	1000	—1417	— 3.49
— 15	2000	— 858	— 2.49
32	2940	— 30	— 1.09
40	3000	0.48	— 1.01
58*	3090	210	— 0.50
Dew point temperature, °F.	*Dew point pressure, lb. per sq. in.*	*H B.t.u. per lb. mol*	*S B.t.u. per lb. mol per °abs.*
120	3300	1805	0.91
200	3150	3184	3.55
282	500	5460	10.20
200	62	4875	13.02
120	17	3270	14.36
40	2.3	2910	16.36

*Critical point

TABLE 5

Component	Mols in feed	Mols in liquid	Mols in vapor
Methane	0.8627	0.03975	0.82310
Ethane	0.0338	0.00410	0.02970
Propane	0.0233	0.00461	0.01861
Butanes	0.0207	0.00619	0.01455
Pentanes	0.0069	0.00305	0.00382
Hexanes	0.0090	0.00550	0.00345
Heptanes plus	0.0436	0.03780	0.00577
	1.0000	0.1010	0.8990

The Vapor

Component	Mol fraction
Methane	0.91600
Ethane	0.03305
Propane	0.02075
Butanes	0.01617
Pentanes	0.00426
Hexanes	0.00384
Heptanes +	0.00643
Pseudo-critical temperature	373.5° abs.
Pseudo-critical pressure	677.1 lb. per sq. in. abs.
True critical temperature	—32°F.
True critical pressure	1318 lb. per sq. in. abs.

Entropy

Consider the vapor as a liquid from 32°F. to its critical temperature, —32°F. The average specific heat for the mixture between these temperatures is 14.80 B.t.u. per lb. mol per °F. The relative entropy for the mixture at —32°F. and 1 atmosphere is:

$$\Delta S = 14.8 \ln \frac{428}{492} = -2.04 \text{ B.t.u. per lb. mol per } ^\circ \text{ abs.}$$

The increase in entropy due to the increase in pressure from atmospheric to 1318 lb. per sq. in, by graphical integration of equation (28), is —0.475 B.t.u. per lb. mol per ° abs. Therefore, the relative entropy of the mixture at —32°F. and 1318 lb. per sq. in. is:

—0.475 — 2.04 = —2.515 B.t.u. per lb. mol per ° abs.

Consider the mixture as a vapor from —32°F. to 120°F. at atmospheric pressure. The average specific heat for the mixture between the two temperatures is 9.35 B.t.u. per lb. mol per °F. The increase in entropy of the mixture due to increase in temperature from —32°F. to 120°F. at 1 atmosphere is:

$$\Delta S = 9.35 \ln \frac{580}{428} = 2.825 \text{ B.t.u. per lb. mol per } ^\circ \text{ abs.}$$

At —32°F. and 1318 lb. per sq. in., the pseudo-reduced temperature and pressure are:

$$T_R = \frac{428}{373.5} = 1.15$$

$$P_R = \frac{1318}{677} = 1.95$$

The increase in entropy, ΔS, between 1 atmosphere and 1318 lb. per sq. in. at —32°F. from Fig. 3 is —12.00 B.t.u. per mol per ° abs.

At 120°F. and 2000 lb. per sq. in. the pseudo-reduced temperature and pressure are:

$$T_R = \frac{580}{373.5} = 1.55$$

$$P_R = \frac{2000}{677} = 2.95$$

The increase in entropy due to increase in pressure from 1 atmosphere to 2000 lb. per sq. in. from Fig. 3 is —11.08 B.t.u. per lb. mol per ° abs. Therefore, the relative entropy for the vapor fraction is:

2.825 + 12.00 — 11.08 — 2.515 = 1.23 B.t.u. per lb. mol per ° abs.

The liquid

Component	Mol fraction
Methane	0.393
Ethane	0.0406
Propane	0.0457
Butanes	0.0613
Pentanes	0.0302
Hexanes	0.0550
Heptanes plus	0.3745

Average specific heat for the above mixture between 32°F. and 120°F. is 39.5 B.t.u. per lb. mol per °F. The increase in entropy between 32°F. and 120°F. at 1 atmosphere is:

$$\Delta S = 39.5 \ln \frac{580}{492} = 6.47 \text{ B.t.u. per lb. mol per } ^\circ \text{ abs.}$$

The increase in entropy from 1 atmosphere to 2000 lb. per sq. in. at 120°F. by graphically integrating equation (28) is —0.833 B.t.u. per lb. mol per ° abs.

Therefore, the relative entropy for the liquid is:

6.47 — 0.833 = 5.64 B.t.u. per lb. mol per ° abs.

The mixture

The relative entropy for the mixture is:

0.899 × 1.23 + 0.101 × 5.64 = 1.675 B.t.u. per lb. mol per ° abs.

Enthalpy

The vapor: The enthalpy of the vapor at 120°F. and 1 atmosphere is from Fig. 10, 3266 B.t.u. per lb. mol.

The increase in enthalpy due to the increase in pressure from 1 atmosphere to 2000 lb. per sq. in. (from Fig. 2) is:

From Fig. 2, $\frac{\Delta H}{T} = -1.81$

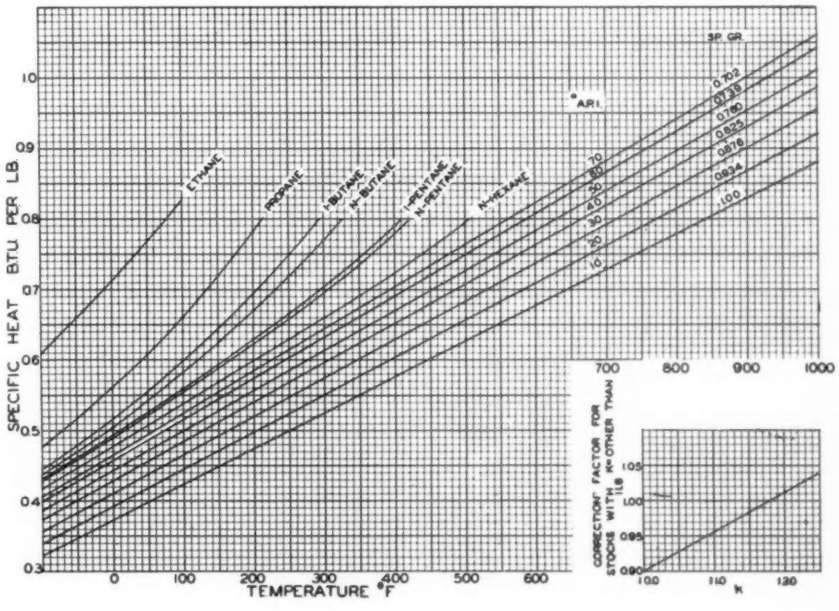
$\Delta H = -1.81 \times 580 = -1050$ B.t.u. per lb. mol

Therefore, the relative enthalpy, H, of the vapor at 120°F. and 2000 lb. per sq. in. is:

3266 — 1050 = 2216 B.t.u. per lb. mol

The liquid: The enthalpy of the liquid at 120°F. and 1 atmosphere

Fig. 9. Specific heat of hydrocarbon liquids



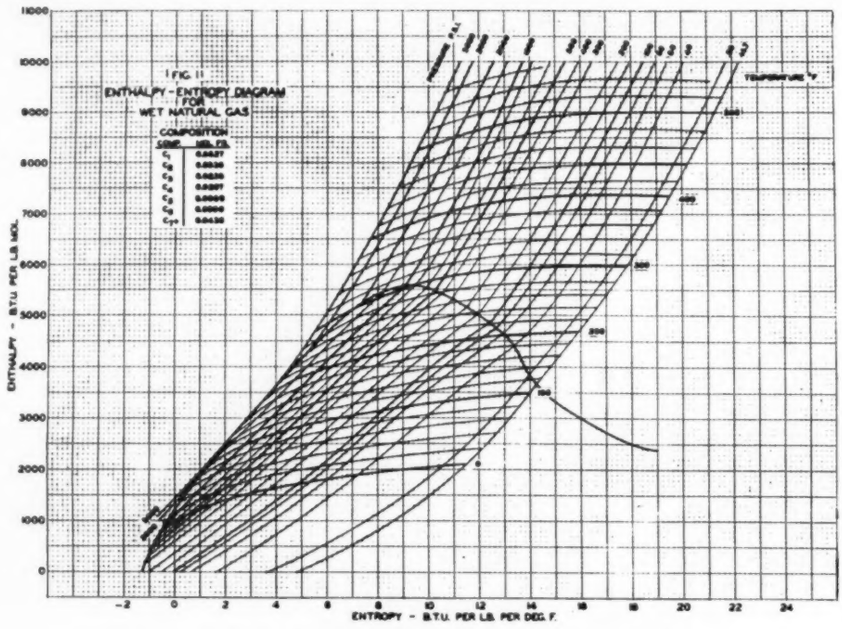


Fig. 11. Enthalpy-entropy diagram for wet natural gas

(A slight error exists in Fig. 11 that should be pointed out. The lines of constant temperature below 100°F. at pressures above 1000 lb. per sq. in. abs. should curve downward more steeply so that the 60°F. line intersects the two phase boundary at a point slightly above point C. The other lines of constant temperature should curve downward in corresponding manner)

from Fig. 7 is 2486 B.t.u. per lb. mol.

The increase in enthalpy due to the increase in pressure from 1 atmosphere to 2000 lb. per sq. in. from graphical integration of equation (1) is 296 B.t.u. per lb. mol.

Therefore, the relative enthalpy of the liquid at 120°F. and 2000 lb. per sq. in. is:

$2486 + 296 = 2782$ B.t.u. per lb. mol

Mixture: The relative enthalpy of the mixture is:

$0.899 \times 2216 + 0.101 \times 2782 =$ 2271 B.t.u. per lb. mol

These values of enthalpy and entropy within the two-phase region were then plotted on the enthalpy-entropy diagram (Fig. 11). Lines of constant quality are omitted to avoid confusion, but the quality can be determined by reading in Fig. 6 the indicated quality for the same temperature and pressure.

The enthalpy-entropy diagram, Fig. 11, may then be used in the same manner as the enthalpy-entropy diagram, Fig. 5, in the April, 1941, issue, *The Petroleum Engineer.*

Acknowledgment

A large portion of the computations for the construction of the enthalpy-entropy diagram was done by C. C. Miller.

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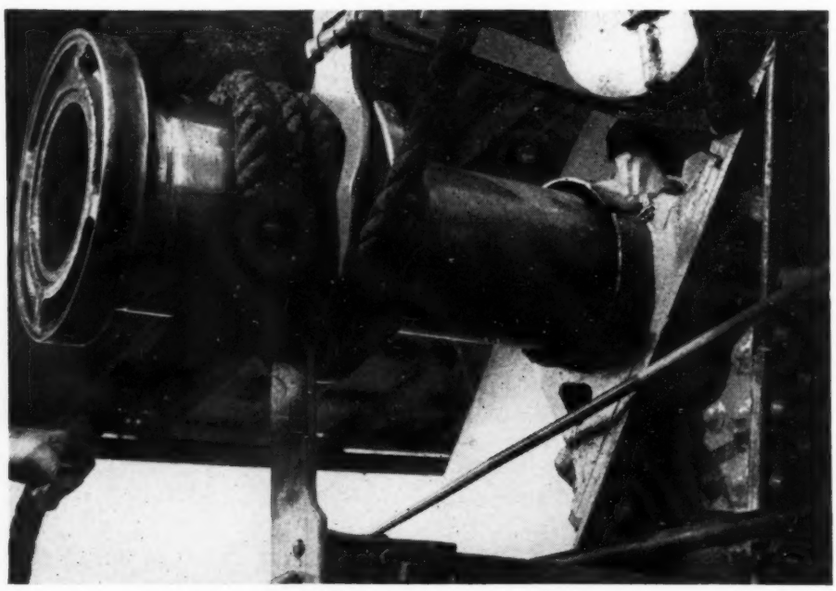
Method of Keeping Rope From Snarling on Cathead



MANY of the most effective safety features on a drilling rig are simple and inexpensive. This is true of the device shown in the accompanying photograph.

The steel divider or finger in front of the cathead serves to keep the working or incoming strand of the cat rope separate from the wraps on the cathead drum. Thus there is no danger of the rope snarling and causing an accident.

The finger is stationary but it is hinged at top and bottom so it may be easily removed when desired.

Fig. 1. A steel mud tank conserves space, reduces volume of mud required

PETROLEUM ENGINEER Exclusive Feature

Medium Weight Drilling Equipment Employed in Deeper North Texas Drilling

☆ Hydraulic couplings on Diesel engine shafts provide desired flexibility in drilling—Rig capable of drilling to 7500 ft. is readily disassembled and moved despite its size

by H. Lee Flood
Associate Editor

AN increasing amount of interest is being directed currently to the drilling activity in the general vicinity of Wichita Falls, Texas — the North Texas area that has been such an important factor in the oil history of Texas since the days of Breckenridge and other early prolific fields.

The discovery of deeper production in the K.M.A. field of Wichita County and in the newer fields of Archer, Clay, Cooke, and Montague counties has made it necessary to employ, in many instances, drilling equipment that is slightly heavier than has heretofore been required in the relatively shallow North Texas drilling. At the same time, however, portable type equipment having increased depth capacity is being used satisfactorily by some operators.

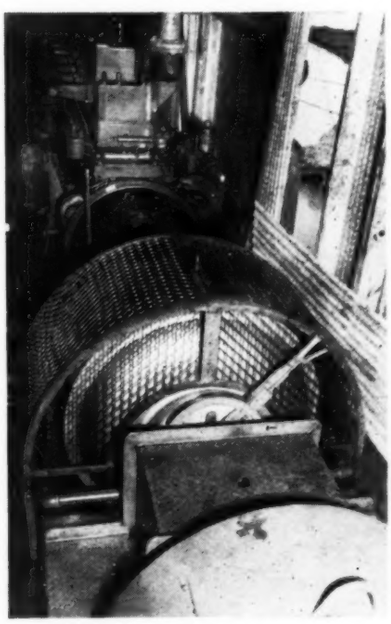


Fig. 2. Hydraulic couplings on drilling engines increase flexibility of control

In some instances, relatively heavy equipment is being moved-in to the North Texas area from other fields in Texas and from other states. For example, the Superior Oil Company, in recent months, has moved the rig here illustrated from South Louisiana to the North Texas area.

The rig, designated as a 7500-ft. assembly, is relatively new and incorporates several features in its design that are extremely interesting.

As a new rig, only one 6800-ft. well was drilled in South Louisiana before the equipment was moved to North Texas. Subsequent to the move, two wells in Montague County have been drilled and completed. At the present time, the rig is drilling its fourth well, a wildcat in the western part of Clay County, approximately 8 miles east of

the town of Scotland, Texas, which, in turn, is approximately 17 miles south of Wichita Falls.

Arrangement

Despite the size and weight of equipment required for 7500-ft. drilling, the rig is easily and quickly moved. The drawworks, two of the 325-hp. engines, and the transmission are mounted on an 8-ft. substructure. Both 15-in. mud pumps are mounted at ground level, one being driven by V-belts from a sheave on the shaft of one of the two drilling engines. The other pump, serving as a standby unit, is powered separately by a third 325-hp. engine.

The general arrangement of the equipment is shown in Fig. 3. All equipment shown except the slush pump is at derrick floor level. Included in the diagram are notations indicating the relative speeds of the various shafts, based on an engine speed of 900 r.p.m. Likewise, the relative sizes of the chain sprockets, belt sheaves, etc., are indicated by showing the number of teeth in the sprockets or the pitch diameters of the sheaves.

Drawworks

The drawworks has a selection of six hoisting speeds and three rotary drive speeds. The heavy-duty transmission unit has three forward speeds and one reverse speed and includes a countershaft and a jackshaft. All power to and within the drawworks is transmitted by means of sprockets and chains, and all shafts are mounted on self-aligning roller bearings. Double chain having a 2-in. pitch is used for all drives except the engine and combination rotary and high-speed drum drives, which are 1½-in. pitch triple and 3½-in. pitch single chain, respectively. The catshaft is powered by 2-in. pitch single chain from the jackshaft.

By including the reverse gear with the drawworks and by the use of close-coupled chain drives, the over-all length and total weight have been reduced to a minimum. The drawworks may be reduced quickly to two sections each 8 ft. in width by unbolting the hoisting drum unit from the transmission unit and disconnecting the chain drives. Overall height of the drawworks is 5 ft. 10½ in.; overall length is 13 ft. 10 in. The net weight of the drawworks and transmission is approximately 35,600 lb.

Hydraulic Couplings

The use of hydraulic couplings on the two main engine drives is perhaps the most unusual feature of the entire assembly. The coupling is mounted on

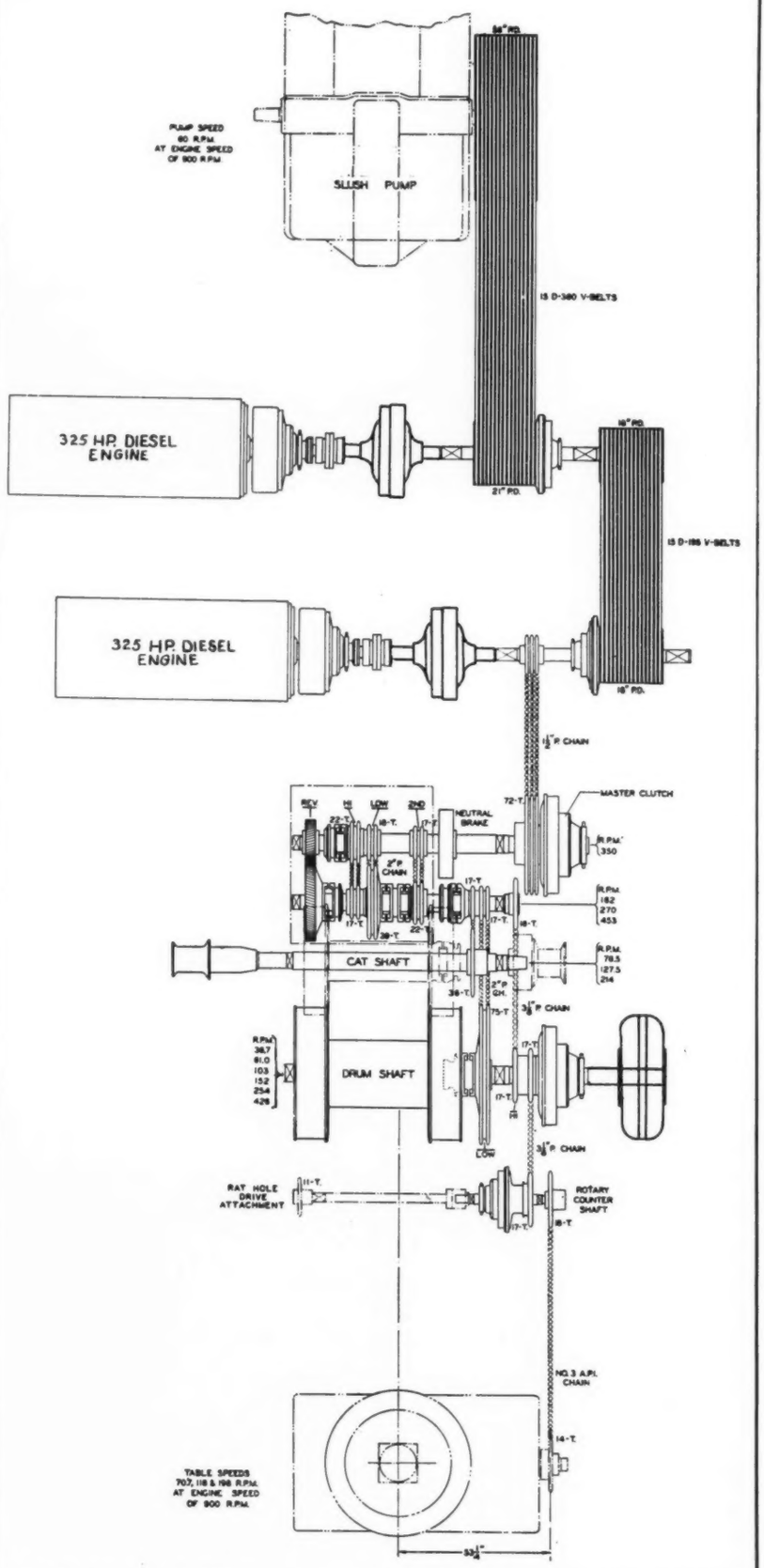


Fig. 3. Layout of drilling equipment indicating relative speeds available

the engine shaft between the clutch and the belt sheave, as shown in Figs. 2 and 7. Completely enclosed by screen wire guards, the couplings require very little additional floor space and virtually no attention is required by the operator, except for occasional routine inspections.

Hydraulic drives have been used in other industrial applications for a number of years but it is only within the last couple of years that they have been adapted to drilling equipment. The point of greatest interest to operators of drilling equipment is the manner in which hydraulic drives provide increased flexibility and ease with which internal-combustion engines may be employed as power for drilling rigs.

Perhaps more is known by the average drilling contractor or other user of drilling equipment of the torque converter than of the hydraulic coupling. As a matter of fact, it has been found that many men in the field either believe "torque converter" and "hydraulic coupling" to be synonymous terms or are confused regarding the basic differences between these two types of hydraulic drive. It is perhaps advisable, therefore, to discuss briefly the essential features of the two drives. For a detailed treatment of the subject, the reader is referred to an article that appeared about two years ago,[1] from which the following excerpts have been taken.

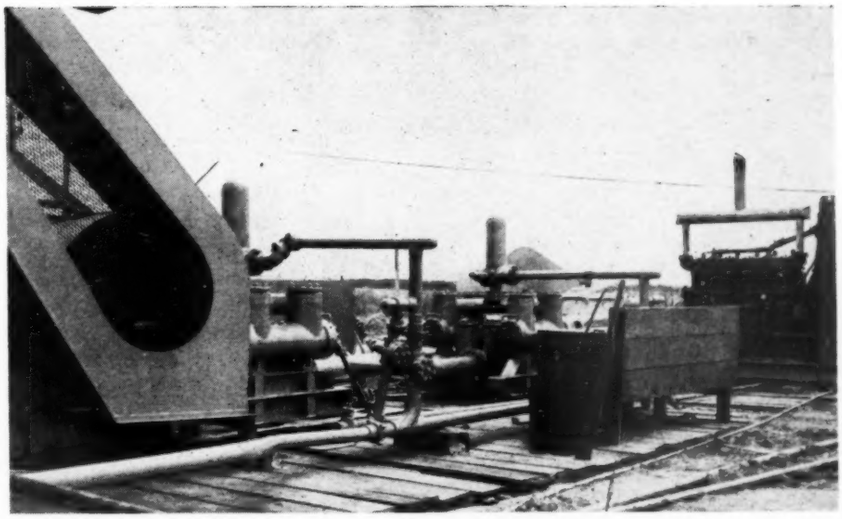


Fig. 4. One of the 15-in. mud pumps is driven by 15 D-section V-belts from above; the standby pump is powered individually by a 325-hp. Diesel engine

"The hydraulic drive . . . endeavors to combine the torque-speed characteristics of the electric transmission with the high flexibility, high efficiency, low weight, and simple controls of the gearbox transmission.

"The advantages obtained with a hydraulic drive are the following:

a. Smooth starting
b. Absorption of shock loads
c. Absorption of engine torsional vibration
d. Limiting torque capacity
e. High torque capacity at low r.p.m."

The above points apply to hydraulic drives in general, both torque converters and couplings. Another point of similarity is that both are of the turbo type rather than the positive displacement type of hydraulic drive. In the turbo type, the action "depends upon the kinetic energy of the fluid discharged by an impeller or pump on the input side against the vanes of turbines or runners. . . . The positive displacement type of drive does not have the shock-absorbing qualities that are so desirable and can be obtained with the turbo type."

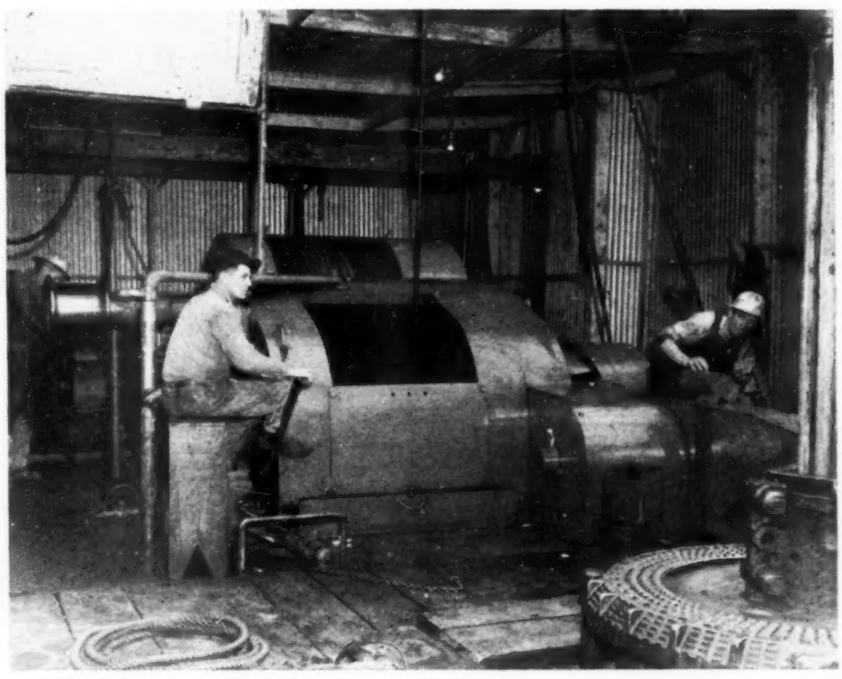
The differences between the hydraulic coupling and the torque converter may be stated briefly as follows:

". . . the coupling is best adapted to constant-speed installations, where slip is required only to compensate for shock loads and overloads (no continuous slip).

"The converter is best adapted to variable-speed installations in which loads are to be started frequently (continuous variable speed operation at constant input speed."

[1] "Hydraulic Couplings and Torque Converters—Their Principles and Design" by R. M. Schaefer, *The Petroleum Engineer*, November, 1939.

Fig. 5. Air-operated clutches on principal controls aid simplified operation of the rig



Mud Circulating System

The two 15-in. mud pumps have a standard liner or bore of 7¼ in. This bore may be altered by changing to liners of 6¾-in., 6¼-in., or 5½-in. diameter.

As already noted, one of these pumps is driven by 15 D-section V-belts from

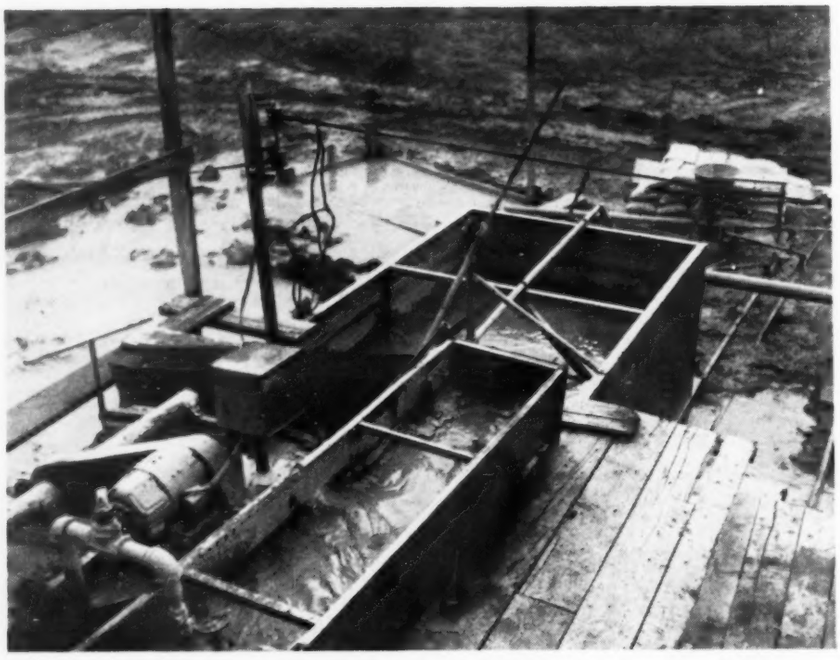


Fig. 6. Mud "ditch" and shale shakers are mounted above steel settling tank

the drilling engines. The standby pump is not used during normal drilling but the 325-hp. engine to which it is connected is in operation at idling speed at all times. This is customary practice as a safeguard against pump failure.

Instead of employing an extensive system of wooden flumes and earthen pits for transportation, settling, and storage of drilling mud, a steel trough and mud tank are used.

The steel trough is attached to the substructure just below the derrick floor and extends along one side of the derrick. Mud returns from the conductor pipe enter the trough at one end and flow out the other end over the two shale shakers, which are mounted above the steel mud tank, as shown in Fig. 6. The shale particles and other cuttings removed from the mud drop over the edge of the tank and accumulate in a pile on the ground.

The suction lines to the mud pumps are connected directly to the steel tank.

The use of the tank and the arrangement in general provides a more compact mud system than is usually found in instances when earthen pits are used for mud storage. The expense of digging pits is virtually eliminated, except for providing storage for waste mud and cuttings. The tank and mud trough are quickly and easily dismantled, transported, and set-up in making a move, thus contributing to the speed with which this rig may be set-up at a new location.

Other Equipment

The rotary table, having a 20½-in. opening, is designed for high-speed drilling to a rated depth of 15,000 ft. The inherent gear ratio of 2.76 to 1 permits a wide choice of rotating speeds by merely changing the size of the driving sprocket. When supplied with a standard 17-tooth sprocket, the table is suitable for conventional rotating speeds. By substituting a 14-tooth sprocket, rotating speeds as high as 350 r.p.m. may be attained.

The crown block comprises six 48-in. manganese steel sheaves, all equipped with roller bearings. Based on a safety factor of 2, the safe working load that may be imposed on the crown is 360 tons, including 300 tons of suspended load; 30 tons in the drawworks line, and 30 tons in the dead line. A 5-sheave 76-in. traveling block is used, to which is attached a 10-in. forged-steel hook. The sheaves in both blocks are grooved for 1⅛-in. line. The line used is a 1⅛-in., 6 by 19 preformed wire drilling line.

A 40-ft. hexagonal kelly and 4-in. external upset internal flush joint drill pipe are used. Approximately 200 ft. of 10¾-in. casing was set and cemented as a surface string. Rock bits are being used to drill a 9-in. hole. The casing for the oil string will probably be 7-in.

For winter operation, the derrick floor has been enclosed with corrugated galvanized iron sheets. The fourble board in the derrick is protected from the wind by a tarpaulin wrapped around and tied to the derrick.

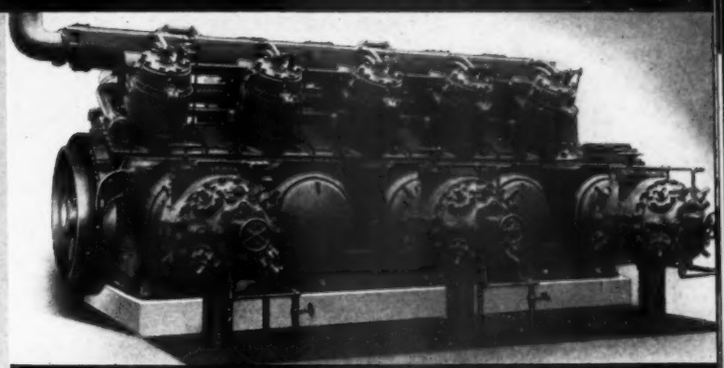
Acknowledgment

Thanks are hereby extended to A. B. Jenks, superintendent, Superior Oil Company, and to representatives of the National Supply Company for their assistance in making the above information available.

Fig. 7. Ample space is provided despite close-coupled transmission and use of hydraulic couplings

Which Compressor ? ? ? ? ? ? ? ?

Type G-MV compressors are for you who want rugged, gas-engine-driven units that are compact and flexible, easy to transport and install, require minimum housing and foundation materials . . . 400 to 1,000 horsepower.



A 1,000-hp Type G-MV Compressor in Cities Service Gas Company's station at Pampa, Texas.

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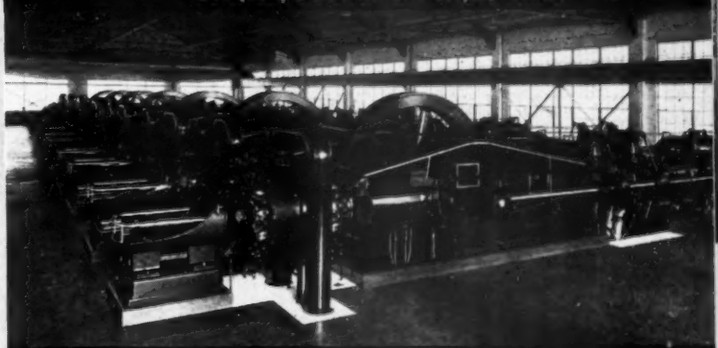

Nine, 1,500-hp, horizontal, engine-driven compressors in a large compressor station.

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A modern 500-hp motor-driven compressor unit in an Eastern plant.

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(Photo by J. E. Hampson—Ark. Nat. Gas Corp.)

General view of plant distillation equipment and storage

Additions to Gasoline Plant Diversify Output

PETROLEUM ENGINEER Exclusive

☆ **Originally erected as a natural gasoline absorption plant, unit now produces blended motor fuel, kerosine, Stoddard solvent, absorption oil, and fuel oil**

by Don Attaway

Safety Engineer, Arkansas Fuel Oil Company

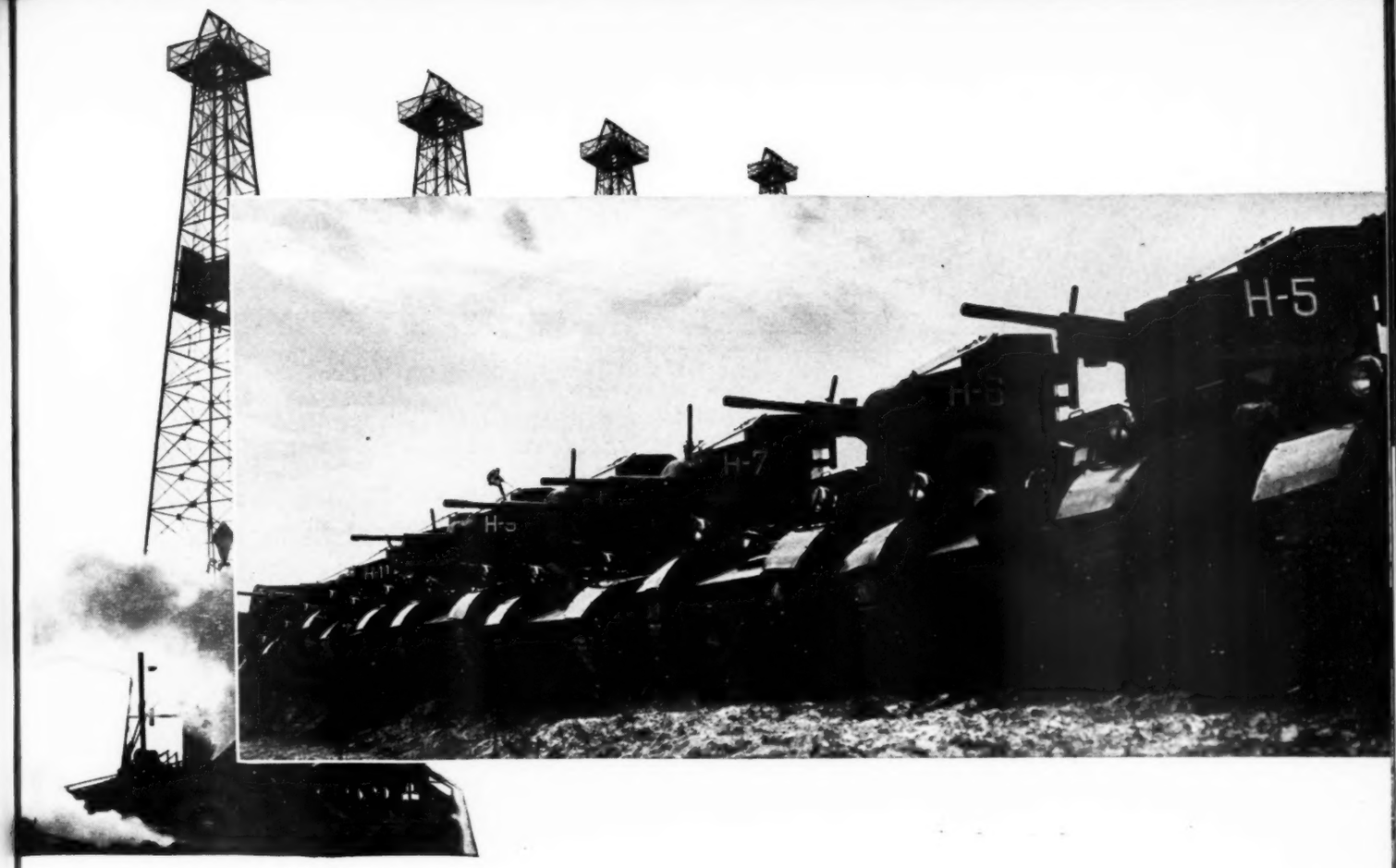
RECENT additional installations of new processing equipment have not only resulted in enlarged capacity, but have transformed the Arkansas Fuel Oil Company's gasoline plant at Waskom, Texas, into one of the most efficient and diversified plants owned by the company. This plant was originally erected as a natural gasoline absorption plant, and placed in operation February, 1940, but since that time a series of additional units has been erected or installed changing the number of products available, but leaving the original layout essentially as designed.

Gas processed at this plant is obtained from 15 gas wells in the Waskom field producing from a depth of approximately 6200 ft. Condensate from several other wells not connected into the gas gathering system is also purchased and transported to the plant for processing.

The plant was first designed for approximately 20,000,000 cu. ft. daily capacity. A successful drilling campaign in the area produced quite a number of additional gas wells and the plant has been expanded to handle a peak load of 40,000,000 cu. ft. Of course, capacity of other processing equipment is such that this peak volume could be handled only for a limited period. The gas processed is delivered into the Arkansas Louisiana Gas Company distribution mains. The original absorber battery consisted of one 40-in. by 40-ft. column and one 36-in. by 30-ft. column. This has been in-

DON ATTAWAY

began his career with the Dixie Gulf Gas Company as timekeeper in the Waskom district, January, 1928—Entered the payroll department of United Gas Company late in 1929 and worked there until he accepted a position with Arkansas Fuel Oil Company in September, 1930, in the gas accounting department—Worked successively as meter man, loading rack man, and utility man in the East Texas natural gasoline plant—Later was transferred to the Shreveport gasoline plant—In January, 1940, he was made safety engineer for the company—His headquarters are in Shreveport, Louisiana.



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General view of blending plant *(Photo by J. E. Hampson—Ark. Nat. Gas Corp.)*

creased by the erection of another 40-in. by 40-ft. absorber and one 48-in. by 35-ft. column.

The flow layout is somewhat unusual but is designed to attain maximum efficiency. The lean oil over the absorbers is pumped by two centrifugal pumps driven by a 100-hp. steam turbine and has a capacity of 225 gallons per minute at 400 lb. per sq. in. discharge pressure. The rich oil from the base of the absorber is trapped into a 36-in. by 31-ft. vertical reabsorber, which also serves as a flash tower by dropping the pressure from 350 lb. gauge to 75 lb. gauge. Vapors released from the rich oil are contacted by countercurrent circulation of lean-oil diverted from the same lean oil stream that serves the absorber battery. From the reabsorber the rich oil passes through two shell-and-tube type heat exchangers countercurrent with the hot lean oil from the bottom of the gasoline still. From these exchangers, the enriched oil is passed into a 60-tube direct-fired horizontal heater and thence is charged into the stripping section of the still proper. This evaporator section is a 4-ft. by 13-ft. vessel from whence the gasoline vapors rise into an elevated 5-ft. by 13-ft. fractionator section.

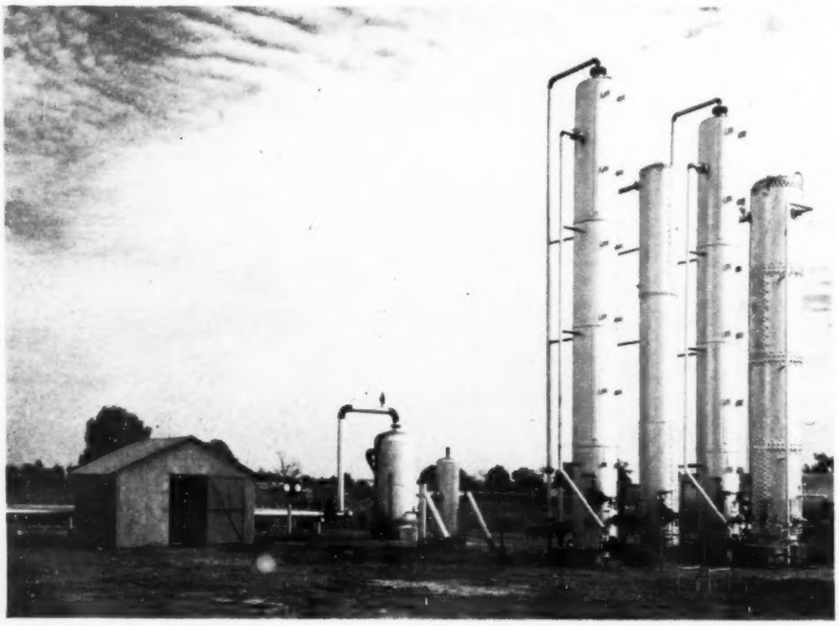
The denuded oil in the base of the still evaporator passes in the usual manner through three heat exchangers and finally to a cooler section composed of two tube-and-shell and one Southwestern type closed coolers. The lean oil then flows into a 10-ft. by 8-ft. surge tank where the absorber charge pumps take suction to repeat the cycle. Two 10 by 4½ by 10 duplex reciprocating pumps serve as standby equipment for the absorption oil circuit.

Condensate Trapped

The above described portion of the flow system is the usual absorption plant layout. Considerable condensate from the field gathering lines is received into the plant, however, along with the gas. Three separators have been installed in the plant yard to trap the condensate into a 7-ft. by 36-ft. flash tank. To effect the separation, the pressure is decreased from 400 lb. to approximately 100 lb. gauge.

From this tank the condensate is passed into a 6-ft. by 10-ft. surge tank at a pressure of 75 lb. gauge. Vapors flashing from these two tanks go into the reabsorber along with vapors from the rich oil surge tank. The condensate is "pressured" from the final or small surge tank through flow controllers into the heat exchangers countercurrent to outgoing hot fuel oil. A second temperature rise is obtained by a single pass through a box-like steam heater and from here the charge is fed into a 4-ft. by 8-ft. vertical gasoline flash tower having seven trays. Stripping steam is admitted to the tower and the specifications of the light gasoline ends removed are controlled with reflux. These enriched vapors are then charged into the reflux (5 ft. by 13 ft.) section of the gasoline still where gasoline vapors from the absorption oil are being fractionated.

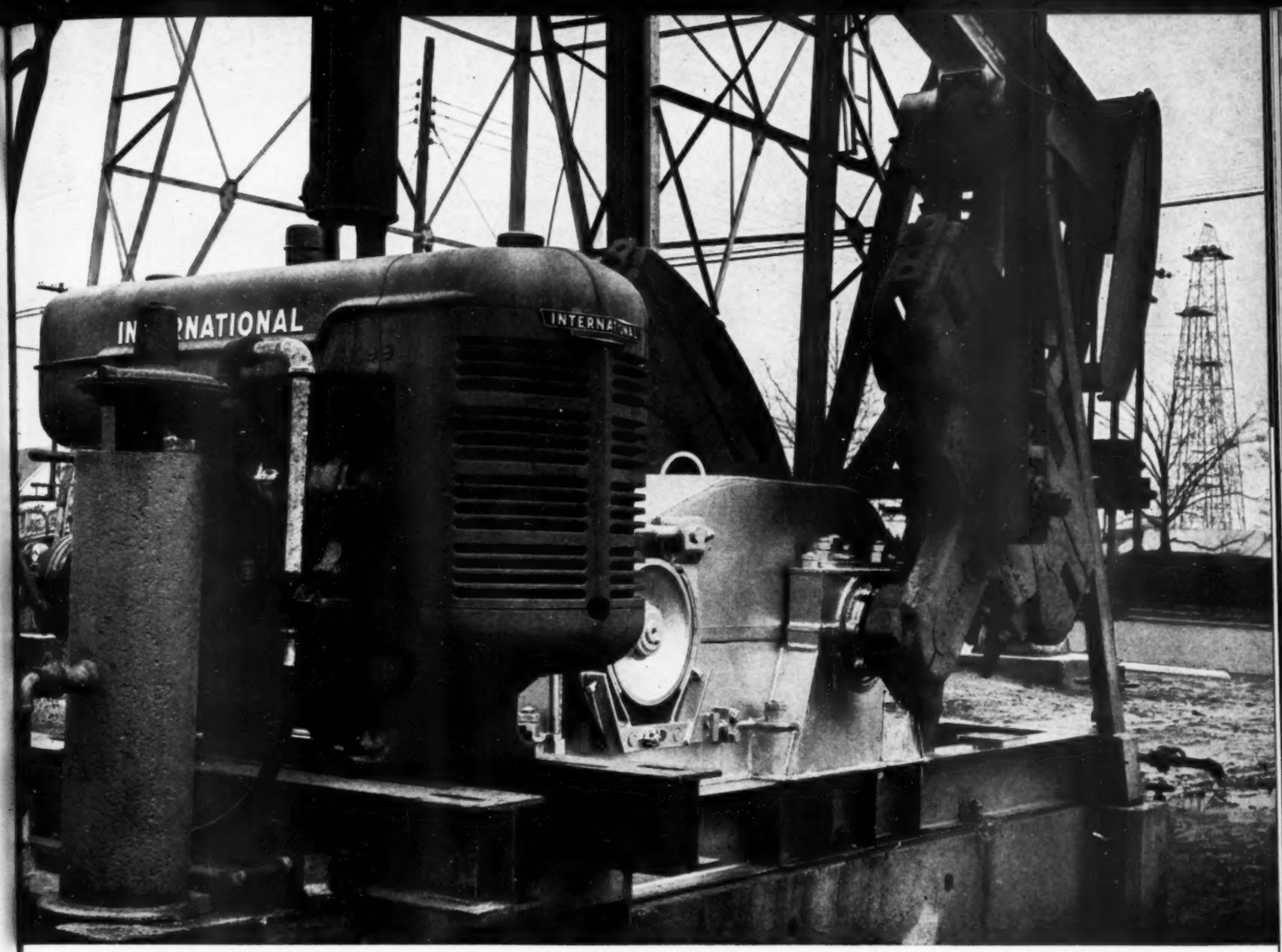
Absorber battery and measuring equipment
(Photo by J. E. Hampson—Ark. Nat. Gas Corp.)



Fuel Oil Production

The fuel oil production is obtained by taking the bottoms from the 4-ft. by 8-ft. gasoline flash tower, minus their light ends, and using them as charging stock to a 20-tube direct-fired heater wherein the temperature is raised to 600° F. This heated charge is then admitted into a 3-ft. by 31-ft. fuel flash tower. This column is refluxed by a 4½ by 3 by 4 duplex steam pump and stripping steam is admitted. The overhead vapors thus obtained pass into a 3-ft. by 31-ft. crude naphtha still, whereas the bottoms are recovered as fuel oil. After passing through heat exchangers and coolers, the finished fuel oil is pumped to a 2500-bbl. storage tank.

The overhead vapors recovered from the fuel flash tower, as mentioned above, are charged into the naphtha still and a kerosine cut taken on the side of this column. This cut passes to an 18-in. by 8-ft. stripper, thence through two closed type coolers and



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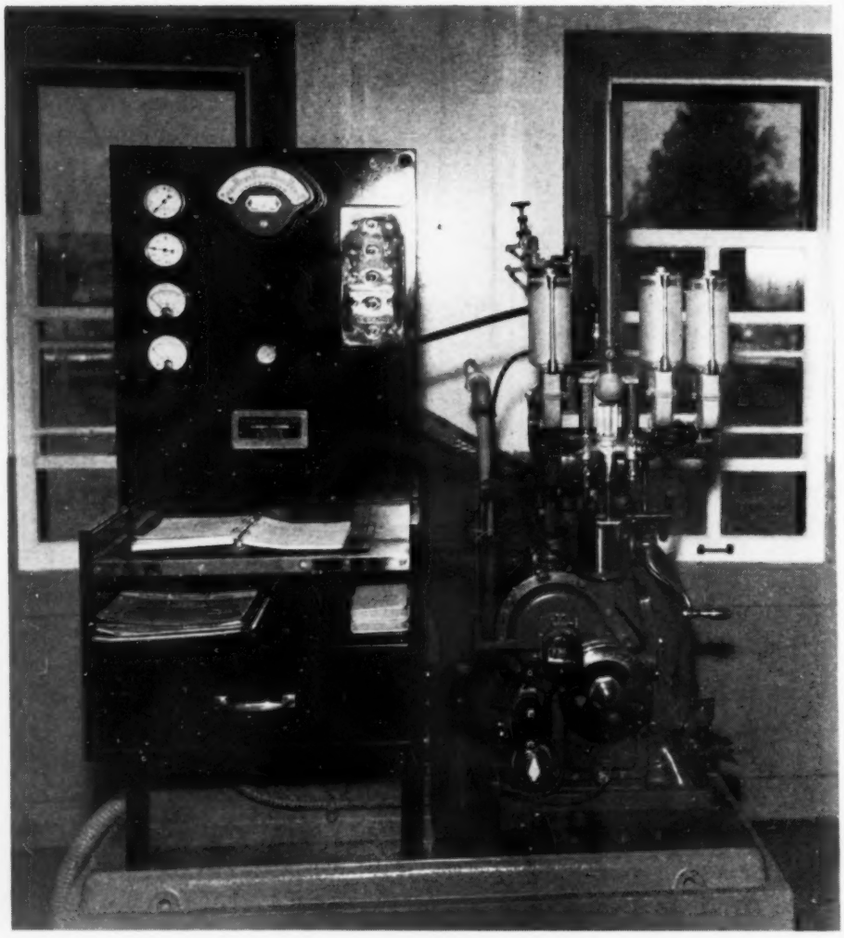

(Photo by J. E. Hampson—Ark. Nat. Gas Corp.)

A.S.T.M. Type CFR motor-method knock rating machine

into a 25,000-gal. storage tank for kerosine.

The bottoms from the naphtha still are used to reflux the fuel oil still and the excess goes into absorption oil production and storage. The overhead vapors from the vessel pass into a naphtha fractionator, which has a steam-heated reboiler constructed within its base. The column receives a small amount of stripping steam and is refluxed from its own raw gasoline accumulator. From the bottom of this fractionator, a Stoddard solvent product is obtained, which is passed through two closed type coolers and finally into one of the two 10,000-gal. storage tanks provided for this product.

The raw gasoline vapors from the overhead of the fractionator section of the gasoline still are passed through a bank of six closed type box condensers and an aftercooler and finally accumulated in a 6-ft. by 10-ft. surge tank. Into this same surge tank goes the overhead product from the naphtha fractionator. From this raw gasoline accumulator, suction is taken by charge pumps to a 24-in. by 60-ft. stabilizer where a 9.75-lb. (Reid vapor pressure) product is obtained having an endpoint of 400° F.

Lead Blending

The latest addition to the plant is the installation of a tetraethyl lead blending plant of the drum-to-3250-gal. weigh-tank type. For this equipment two 5000-bbl. blending tanks have been erected. This leaded gasoline is produced under regulations of the Ethyl Gasoline Corporation and the production is a Q grade gasoline.

For this added unit, an extension to the laboratory was made to house an A.S.T.M. CFR motor-method knock-rating machine. Power for this piece of equipment was not available at the plant and about one mile of high line was erected in order to provide 220 v., 60-cycle, a-c. current for machine operation.

Perhaps the most interesting feature of the plant is that although it is a natural gasoline plant by design and name, it does not produce or market natural gasoline. All such production is used in the process of blending motor fuel, which is marketed along with the plant's other production of kerosine, Stoddard solvent, absorption oil, and fuel oil.

Steam Plant

Steam for plant operation was initially generated by three 85-hp. and one 125-hp. oil-field type boilers. The installation of additional steam preheaters and pumps necessary to serve the new and expanded processes demanded that additional boilers be connected. Consequently, two boilers, one 95-hp. and one 85-hp., were installed, requiring an expansion of the boiler house to 62 ft. in length and 23 ft. in width. The building is of the usual structual steel and sheet-iron type. All boilers are equipped with automatic firing devices and boiler feed water controls.

Water Wells

Two water wells, each 90 ft. deep, on the plant site sufficed to supply water for the plant's early requirements until difficulties with iron content were encountered, whereupon a 5-acre lake was constructed in which surface water could be impounded as makeup for boiler feedwater. At the same time a complete exhaust steam recovery system was installed further to conserve suitable boiler water. A 15-hp. gas engine driving a 5 by 8 reciprocating pump by means of multiple V-belts was placed on the lake edge to pump water for boiler consumption. All return steam condensed in the exhaust system is returned to the lake through a spray system.

The water system for the coolers and condensers continues to be supplied by the original water wells and the five-bay aërator type cooling tower has been expanded by two bays to provide ample facilities for this cooling service.

Miscellaneous

Two steam-turbine-driven generators situated in the boiler house generate 110 d-c. current for plant lighting, and elevated flood lights are used throughout the plant for night illumination. A 6-ft. Cyclone fence circles the plant site and modern fire-fighting equipment is conveniently situated through the plant. Emergency valves and shut-offs are grouped in the near part of the plant for use in case of fire or accident.

The plant is equipped with a 4-car loading rack situated approximately one mile north of the plant site on the Texas and Pacific railway. All plant production of motor fuel and about half of the kerosine is moved by tank car, and the other products are transported by tank truck.

——☆☆☆——

Merry Christmas and a Happy New Year

from

THE LARKINS

Jim Bill John

Is Safety Being Over-Emphasized?

PETROLEUM ENGINEER Exclusive Feature

☆ **Does over-zealousness for safe operation on part of those in charge cause workmen to be "accident conscious" rather than "safety minded?"**

by J. A. Campbell

Research and Development Engineer

EVEN the title of this article may be branded by many safety engineers as rank heresy. "You can't overemphasize safety," they say. "It is something you have to keep hammering at all the time. You have to keep the men continually reminded of the danger of their work so that they will be careful."

Is it not possible that we have given so much attention to the physical prerequisites for safety that we have not given proper consideration to its psychological aspects? We have equipped our plants with automatic controls and the most approved safety devices. Most of them are very dependable. We understand their operation and can predict their response to changing conditions but the *genus homo* is a horse of many different colors. The human element is the big uncertainty in all our operations. You never know when a human being will go "hay-wire." You can equip your plant with every known automatic control and safety device that any insurance inspector could suggest, but sooner or later somebody will "pull" an accident that just simply isn't in the book.

I believe that many of our efforts toward getting the men "safety-minded" have been directed along lines that have made workmen "accident minded" instead of obtaining our objective.

As an employer I have always felt a keen sense of responsibility for the safety of my men and have made an intensive study of safety, not only from the physical, but from the psychological approach. In handling the construction of 50 gasoline plants we had no fatalities and only one hospitalization case and the victim was back on the job in 30 days. We handled large crews and built 30,000-gal. plants in 30 days. We crowded large plants in between oil derricks on city lots. At one plant where the noise of blowing gas was so great we could not give any verbal instructions to the men everything had to be written out. We had the best insurance rating for any contracting firm engaged in this type of work. Men were hard to get and we could not be "choosey." For one job at Baldwin Hills we had to pick our labor crew from movie extras from Culver City. One of them asked me for a hand ax so he could cut down a pick handle until it would go into the head!

J. A. CAMPBELL

entered employ of Union Oil Company in 1917—Occupied at various times the positions of research engineer, construction engineer, superintendent of construction, design engineer, and engineer of gas plants—In 1923 accepted the position of chief engineer of the Lomita Gasoline Company, Long Beach, California, acquiring an interest in the company—In 1924 formed the J. A. Campbell Company and engaged in the design and construction of absorption plants for the next eight years—In 1932 retired from the contracting business to enter field of research and development—At the present time, he is vice-president and chief engineer of the Lomita Gasoline Company, president of J. A. Campbell Company, manufacturing and development engineers, engages in natural gas consulting work, and is an officer or director in five other companies engaged in various activities in southern California—Is a graduate of Ogden College and Yale University.

We built the cooling tower framing in sections, raised the first section, guyed it four ways, and pulled the other sections into vertical position from the top of the first. One of these men (who said that he had been a sailor) was sent to untie the preventer, a back guy to keep the section from going past vertical. I heard the swish of falling rope and looked up to find that he had untied and thrown down both guys from one end and was "shinnying" across to release the other two, leaving the frame supported only by "skyhooks." Handling such inexperienced men safely is a terrific strain and how we ever completed that job without an accident has always been a mystery.

We have a motto in our shop that reads, "If it works at all it can be made to work right, provided it is not a human being." In tackling a mechanical problem we have as aids certain established infallible laws and rules. The laws pertaining to human conduct are very poorly established and every human being can be a potential exception. If we are responsible for the conduct of human beings, however, we must learn what we can about the general laws governing human behavior and particularly must we learn the necessity for studying each case individually.

Value of Foremen

One of the greatest values of having a foreman for the small gang is giving him this opportunity of sizing up the men and placing them where they can work most effectively and do the least hurt to themselves and their fellow workmen. The real responsibility for working safely falls on the foreman and he either has a natural ability to assemble the material and equipment, assign the work, and prescribe a safe approach, or he hasn't. If he hasn't this natural ability, it is my experience that

Only MISSION PLUG VALVES

Give You All

1. Longer Life
2. Easy Operation
3. Trouble-Free Service
4. Safety from Gas Leakage

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1. Automatic Lubrication.*
2. Full-Port Lubricant Sealing Grooves.
3. Wedge-Proof cylindrical Super-Surfaced Core.
4. Sealing Grooves on Plug never pass Ports.

1. **AUTOMATIC LUBRICATION**—Provides a constant lubricant seal • Line pressure automatically forces lubricant from reservoirs to sealing grooves • Eliminates necessity of frequent operation of lubricant screw • Ample downstream (sealing end) lubrication • Reduces friction—valve turns easily • Reduces wear and extends life of valve

2. **FULL-PORT SEALING GROOVES**—Sealing grooves encircle ports — assures complete uniform seal • Provides a dependable seal against high pressures, liquid or gas • Full-Port Lubrication thoroughly lubricates core — valve operates easily • Reduces washouts • Reduces wear and extends life of valve

3. **WEDGE-PROOF SUPER-SURFACED CORE**—Cylindrical Core positively cannot wedge—permits easy turning • Perfect fit of core to body conserves lubricant and maintains leakproof seal longer • Lubricant lasts longer . . . saves time . . . saves valves • Super-Surfaced core provides extra resistance to abrasives and corrosion agents • Reduces wear — lasts longer

4. **SEALING GROOVES ON CORE**—Never exposed to fluid • Prevent loss of lubricant into fluid line . . . insures constant seal • Protects sealing grooves on core from direct cutting action of fluid • Lessens intrusion of abrasives into lubricant sealing grooves . . . reduces wear on vital sealing surfaces • Prolongs life of valve

* When lubricating a Mission Plug Valve, a portion of the lubricant is forced into reservoirs. Thereafter, the line pressure AUTOMATICALLY feeds this stored lubricant, as needed, into the down-stream seal grooves. So long as lubricant remains in the reservoir a perfect seal is assured.

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EXPORT OFFICE: 30 ROCKEFELLER PLAZA, NEW YORK

his chance of acquiring it is about one in ten. A discerning foreman can put two men to work at moving lumber only a few feet and quickly tell whether they are safe workmen.

A Common Cause of Accidents

Practically all accidents are an attempt to violate an inviolable law of physics—two objects cannot occupy the same space at the same time. When you drive an automobile you have a certain clear space in front of you and you endeavor to keep such a space available. If the clear space in front of you lengthens you can safely speed up. If it shortens you must slow down. In order for you to drive, you must have a certain amount of this clear space ahead. If someone suddenly cuts into this clear space you must quickly stop, slow down or change direction so as to head into another clear space upon which someone else may have designs, or have an accident. Show me a workman who is continually having automobile accidents and I will show you a man who is an unsafe workman. Some men are naturally careless; they do not look out for the other fellow. They are poor men to have working in a team. They are always getting hurt or hurting someone else. You can spot this type of man by watching him for five minutes. His movements are abrupt and unplanned. Before picking up material to move it he does not look around to size up the situation and judge his clearances. Let him drive a car and you will note that he is constantly cutting in and out without proper observation of his clear space nor with any respect for the clear space of others. Such men, when I have to use them, I place working by themselves at something quite safe.

Selection of Foremen Important

Many men have altaphobia—they cannot work up in the air. Before sending a man aloft for the first time a foreman should ask him if he is accustomed to working off the ground. Many men have a terrible fear of being 10 ft. up but will go up on being told to do so. A competent foreman can spot such a man as he starts up a ladder or scaffold. They should never be allowed to get off the ground.

A good construction foreman is a good housekeeper. He keeps his material neatly piled and well spaced. As soon as forms are taken off he will see that nails are removed and kept off the ground and the boards piled up. He will keep obstructions out of paths over which material is carried. He will watch his rigging and keep his cables and rope out of water and dust and will replace them when they show evidence of weakening from wear or abuse. All these precautions have a decided psychological effect upon the men as well as making their work physically safer. If a man is afraid he is going to have an accident, he is very likely to have one.

The foreman and the supervisors should be carefully selected. They are the men with whom the management should work out the safety program, never with all the men in a group. It is all right to give the men first-aid training and certain fundamental rules for safety but the practice of having an outside safety man come in and describe in horrible detail the latest accidents in the industry and outline how they could have been prevented, is extremely bad psychology. Posting pictures of accidents is worse. Men should not be continually reminded that their work is dangerous. If they are so "dumb" that they can't tell dangerous work from safe work, they should not be on the job. Accidents run in series, not because of any jinx but because of the psychological effect. Have you ever started out in your car in the morning for your office or plant and almost had an accident at the first crossing? If so it seems that at almost every intersection some one gets in your way. That isn't coincidence; it is a state of mind. It was the effect upon your driving of that first close call.

Accidents in plants run the same way. A plant may go smoothly for a long period without an accident and then be beset with a whole series. I know of one plant that had an enviable safety record. Suddenly a series of accidents began. A safety engineer was called in and all men available were brought in to listen to his talks. The accidents increased. One afternoon while they were holding a safety meeting two men were severely hurt in different locations in the plant. The policy was quickly changed and only department heads and foremen were asked to attend the safety meetings and the jinx was broken.

Power of Suggestion

The power of suggestion is a very potent psychological influence. About two years ago I attended, with my family, the Los Angeles County Fair. We were passing through the exhibit of horses. Finally we came to a horse that was standing with its legs spread and its head drooped. Despite the fact that there was a posted sign reading, "Do not pet, sick," I was amazed to notice that an apparent majority of those who passed stopped to pet this "woozy-looking" horse. Becoming interested, I told my group to go on, that I was going to make some observations on human behavior. In the stall just ahead of the sick horse, which we will call No. 2, was a beautiful, very gentle chestnut mare that we will designate as No. 1. No. 3 next in line beyond the sick horse was an attractive pony. I kept tab on the next hundred people who passed through. Seven petted No. 1, 58 petted No. 2, the sick horse with the sign on its stall, and 29 petted No. 3. Had the sign not been there I do not believe 3 people would have touched the animal.

Permit an example more in line with our subject. My two sons work in the shop in the summer as apprentice machinists. I set the younger to grinding thermometer wells and polishing them on a high speed spindle. I made the mistake of cautioning him in using the strip of emery cloth, not to get his thumbs too close to the revolving well. He had performed the operation many times before. It wasn't two minutes before he had caught his thumb and blackened the nail. I called the older boy who had polished hundreds of these wells and said, "Now for goodness sakes, be careful and don't do what your brother did." It wasn't a minute before he had caught his thumb. It was a rush order and I was rather disgusted so I took over to show them how the job should be done. It was an operation that I had performed hundreds of times before without the slightest fear of getting injured, and I have done it many hundreds of times since but on the first one I tried, in some manner that I have never been able to figure out, I got two blackened thumb nails—and was my face red!

I have a friend who is general superintendent for one of the large companies with many plants under his supervision. He has a fine safety record. They phoned him one morning of a serious accident at one of his plants. He got in his car, drove 100 miles, arrived at the scene and made a quick survey. He got all the men into cars except one whom he left as a watchman, and, leaving things as they were, drove 10 miles to the nearest town. He ordered a good meal for all the men and they stayed for two hours talking about hunting, fishing, golf, and bowling. Then they went back and lit into the job and had the plant running by night.

In summation, we will do well to use great care in the selection of our foremen and supervisors, giving them every aid in the way of automatic controls, safety devices, and instruction, but taking care that in our zeal for safe operation we do not make our men "accident conscious" instead of "safety minded."

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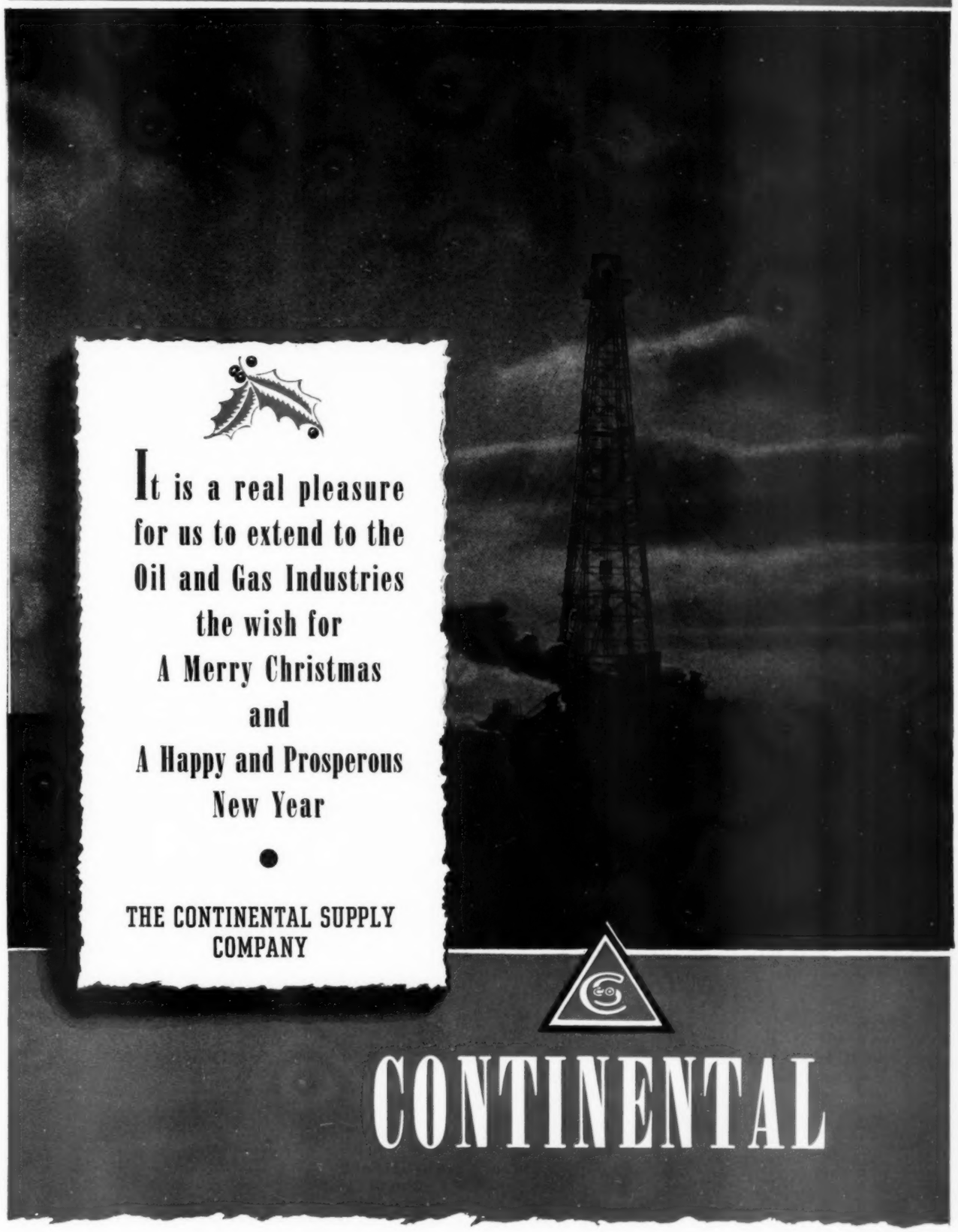

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for us to extend to the
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the wish for
A Merry Christmas
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Elements of Orifice Meter Operation and Maintenance

Part 2

by J. W. J. Bercher
Tide Water Associated-Seaboard Oil Company

A photograph and biographical sketch of the writer can be found on page 86 of the November issue of *The Petroleum Engineer*, in connection with Part 1 of this article.

The Orifice Meter

SINCE the invention of the orifice meter in 1911, with its enclosed recording differential gauge having a range of 0 to 60 inches of water, commonly called the "bombshell" type, many types of orifice meters and recording differential gauges have been perfected.

Probably one of the greatest steps forward in the design of differential gauges was in the development of the mercury float type recording differential gauge, which followed the invention of the "bombshell" type of enclosed recording differential gauge.

Although the modern orifice meter is generally regarded as a scientific measuring instrument, it must not be taken for granted that after it is once installed it will give perfect satisfaction without care and attention. Although the orifice meter has many advantages, especially in measuring high-pressure gas, it must be given careful attention, just the same as the large capacity or proportional meter. The orifice meter is a very delicate instrument, and consequently must be checked and tested periodically.

Any inaccuracy found in either the differential or static pressure gauge or in the specific gravity of the gas measured can be expressed in percentage figures, fast or slow, just as when proving a proportional meter.

The formula for computing flow by means of the orifice meter is identical with that for the Pitot tube except that the coefficient for an orifice of given size is smaller than that of a tube of the same size, due to the lower "efficiency," or coefficient of flow.

Speaking in the most elementary terms, the orifice meter is simply a hole to push gas through and a glorified recording mechanism. In other words, we create a disturbance in the line, measure and record the intensity of the disturbance, and from the record we are able to calculate the amount of gas passing through the line.

The device used to create the disturbance is a restriction in the line. This may take the form of a flow nozzle, a venturi, or a flat plate orifice. A venturi throat is theoretically very accurate but is not used in practice a great deal because of difficulties in manufacture. The commonest use of the venturi is in the carburetors used on internal-combustion engines. The Venturi throat was invented in 1797 by the man whose name it bears. In use, the flow of gas or liquid through the Venturi produces a low-pressure area at the point of greatest restriction (see Fig. 4) and the pressure drop at this point is proportional to the velocity of the gas or liquid through the Venturi. In the carburetor this low-pressure area is utilized to draw gasoline from the carburetor bowl.

For accuracy, the Venturi must be curved in accordance with definite patterns varying with the velocities at which they are to be used. The cost of manufacture and the changes in calibration resulting from even slight changes due to corrosion or wear make their use extremely rare in industry.

The flow nozzle, shown in Fig. 5, is a Venturi throat from which the tail section has been removed. It is subject to the same objections in general that apply to the Venturi. There is some theoretical advantage in using a nozzle, but the great cost and the extreme care that must be used in handling them render nozzles, like Venturis, useful only in rare cases. In general, they are used only for very accurate test work and as more is learned of the action of the flat plate and greater accuracy in calibration of the plate becomes possible, it is quite likely to crowd the Venturi and flow nozzle out of the picture. The flat plate orifice, or more commonly the orifice plate, is shown in Fig. 6. In this figure an effort has been made to show the path of flow assumed by the liquid or gas in passing the plate and the pressure variation resulting. It will be noted that the flow pattern is very nearly the shape of the Venturi throat and that the upstream pattern is very nearly the shape of the flow nozzle. This resemblance comes from the fact that the Venturi and the nozzle are shaped from a calculated flow pattern with the purpose of eliminating the eddy currents set up

Fig. 4. Venturi tube

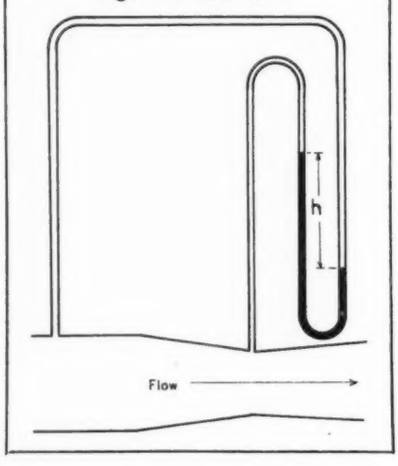
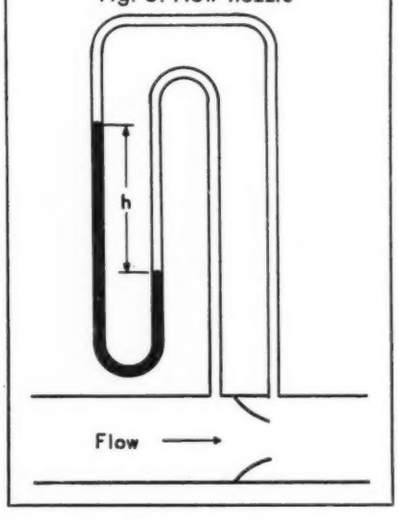
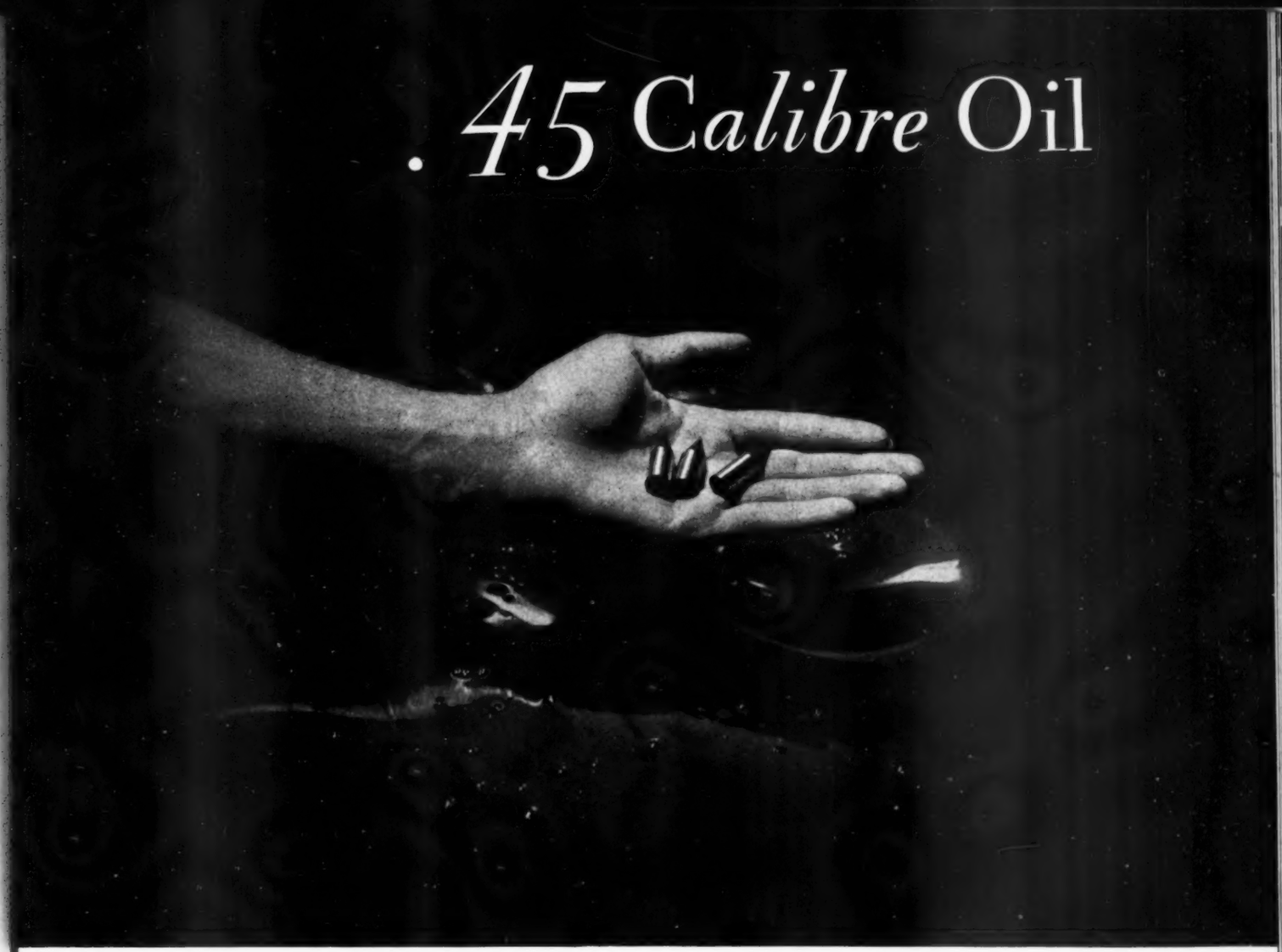


Fig. 5. Flow nozzle



.45 Calibre Oil



The story of drawing a bead on a billion barrels of crude

NATURE locked its precious store of "black gold" beneath countless tons of earth and defied man's ingenuity to release it. As oil fields were discovered, pioneer wells were drilled to exploit the richest oil deposits because these were the easiest ones to produce. In the mad scramble for greater oil production during the 'twenties, thousands of wells were hastily drilled. The thin, shallow, secondary zones were cased and consequently were sealed-off. Production from these secondary zones was lost until Lane-Wells engineers devised a gun, small enough to fit inside oil well casing, yet powerful enough to shoot bullets through as many as three strings of cemented casing and far out into the producing formation to open the flood gates of these "forgotten reserves."

These 45 caliber bullets are indicative of the great strides of progress made by the oil industry during the past decade. As a result of Lane-Wells Gun Perforator Service and the field techniques it made possible, greater U. S. oil reserves are available for use today than ever in the past. The costs of completing oil wells has been materially reduced. The ultimate production of each well has been substantially increased.

Oil well operators in every field acknowlege the value of Lane-Wells Gun Perforator Service. They have used it to draw a bead on well over a billion barrels of crude during the past eight years.

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100,000 BBLS. OF OIL FROM AN ABANDONED WELL

Union Oil, LaMerced # 17 had been abandoned for 3 years when Lane-Wells Gun Perforated in December, 1932. Production was restored and the well has produced more than 100,000 barrels of oil since.

LANE-WELLS TECHNICAL OIL FIELD SERVICES *.. wherever men drill for oil*

PUTTING OIL EXPLORATION ON A SCIENTIFIC BASIS

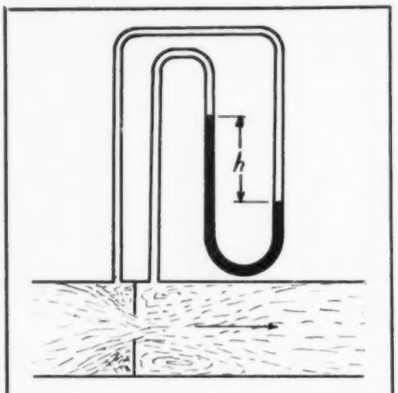

Fig. 6. Flat plate orifice

in the dead spaces outside the flow pattern for the flat plate. Energy and consequently some efficiency are lost in these areas but with proper evaluation of the basic orifice flow factors this loss is compensated for and can have but little effect on the final values.

Plate Accuracy

Inasmuch as the plate is used so generally in modern orifice meters, it will probably be worthwhile to take up all the factors affecting its accuracy. It is often concluded erroneously that, inasmuch as the plate is a basic part of the meter and is seldom seen, nothing can go wrong with it. This is far from true. The plate must conform to very rigid specifications. The following paragraphs are quoted from Gas Measurement Committee Report No. 2 as issued by the American Gas Association:

"The thickness of the orifice plate shall be at least 1/16 in. For use in pipes of over 4-in. inside diameter the thickness shall be at least ⅛ in. and not over ¼ in., except that for pipes 16 in. and over in diameter the thickness may exceed ¼ in.

"The upstream face of the orifice shall be as flat as can be obtained commercially and shall be perpendicular to the axis of the pipe, when in position between the orifice flanges. Since perfect flatness is difficult to obtain, any plate which, when clamped between flanges does not depart from flatness along any diameter by more than 0.01 in. per inch of pipe radius shall be considered flat.

"The upstream edge of an orifice shall be square and sharp so that it will not appreciably reflect a beam of light when viewed without magnification. It shall be maintained in this condition at all times. Moreover, the plate is to be kept clean at all times and free from accumulations of dirt, ice, and other extraneous material.

"The thickness of the orifice plate at the orifice edge shall not exceed:

1. 1/30 of the pipe diameter, D_1
2. ⅛ of the orifice diameter, D_2
3. ¼ of the dam height, $\frac{D_1 - D_2}{2}$

the minimum of these requirements governing in all cases. It is recommended that wherever practicable the requirement (1) be reduced to 1/50 of the pipe diameter, D_1.

"In some cases the thickness of the orifice plate will be greater than permitted by these limitations, and in such cases the downstream edge shall be cut away (beveled) at an angle of 45° or less to the face of the plate. All orifice plates which are beveled should have the square-edged side (i. e., the side opposite the beveling), stamped 'Inlet.'

"It is recommended that for the commercial measurement of gases the orifice to pipe diameter ratio "B," (D_2/D_1), be limited as follows:

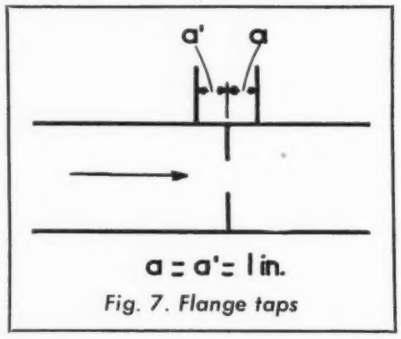

Fig. 7. Flange taps

(a) With meters using "flange taps," "B" shall be between 0.15 and 0.70;

(b) With meters using "pipe taps," shall be between 0.20 and 0.67.

"With either type of pressure tap, diameter ratios as low as 0.10 may be used, while ratios as high as 0.75 may be used with flange taps and as high as 0.70 may be used with pipe taps. The flow constants for these extreme values of 'B' are subject to higher tolerances, and the use of these extreme ratios is to be avoided wherever practicable."

Pipe Requirements

In addition to these specifications one finds additional requirements governing the pipe into which the orifice plate is placed. These specifications are just as important as those just quoted. If the gas flow does not reach the plate in the proper manner, the plate cannot properly perform its duties. Details of the specifications governing the meter runs may be found in Committee Report No. 2 of the A.G.A. Because of the highly technical nature of this part of the report it is not quoted in full. Briefly it is required that the construction of the run be such that the flow is centered upon the plate, that the flow approach the plate with the minimum distortion of flow, and that there be no obstructions to flow in the meter run.

Pressure Taps

After all the above conditions are met the desired pressure taps, or meter connections, are provided and the meter attached. The pressure taps may be any of three types, flange taps (Fig. 7), pipe taps (Fig. 8), and corner taps (Fig. 9). The type of taps used is a matter for the gas engineer to decide; the type used has small effect on the action of the meter. Corner taps are seldom used in the United States and as flange taps give greater differentials than do pipe taps, flange taps result in slightly greater accuracy. The orifice coefficient varies with the type of pressure taps used and if the coefficients are accurate it makes small difference in the final result. This subject will be covered in the section on chart reading.

The piping from the taps to the meter must be pressure-tight and all lines should drain back to the connections at the flange. Any restriction to flow should be avoided and in no case may the lines be of unequal size. It is best to have the lines of equal or nearly equal length. This ideal is difficult to attain in practice but it should be kept in mind, and large differences in length avoided.

Differential Action

An analysis of the action of the U-tube or manometer, or, as it is more often referred to in meter work, the differential gauge, will probably more clearly demonstrate the reason for the rules laid down above concerning the meter piping.

This differential gauge is the same U-tube, in principle, that was used in the "Open Flow Tester" and the Oliphant Pitot tube with the one difference that the basic device has been harnessed and made to leave a continuous record. The orifice meter, as we know it, dates back to 1911 when a float was placed in the U-tube. This float is linked to a pen arm through a suitable pressure-tight bearing and it is this linkage that provides the differential record on the chart.

Inasmuch as mercury is sufficiently heavier than iron to make an iron float practicable and as mercury does not form an amalgam with iron, iron floats are used. In calculating the size float to use and the size of the chambers in the meter, considerable mathematical work is required to insure accuracy in

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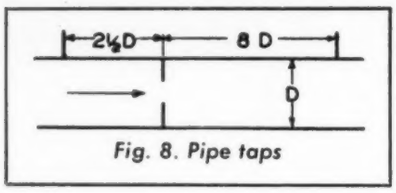


Fig. 8. Pipe taps

the meter records. No effort will be made to outline this work for the purposes of this article.

In all meters the differential or pressure drop across the plate is recorded in inches of water. The reason for this usage lies in the fact that since the earliest days of the Pitot tube, water has been used in manometers for the purpose of measuring relatively low pressures and so when pressure drops across plates were measured by the early experimenters this standard was used and the coefficients were calculated on this basis. There is now no reason other than usage to prevent the use of some other standard but as the inch of water is generally accepted it will probably continue in use.

There is a relationship in hydrostatics known as the hydrostatic paradox, which states that the downward pressure exerted by a column of liquid depends only upon the height of the column and is not influenced by the cross-sectional area of the column. There are a number of experimental proofs of this fact to be found in the literature. The pressure on the bottom of the column is then a function of the height of the column and the density of the liquid used, and is independent of the cross-section of the column. So that if mercury is used and the height of the column is desired in inches of water the height of the mercury column in inches need only be multiplied by the density of mercury divided by the density of water, or, in other words, by the specific gravity of the mercury, and the result will be the corresponding pressure expressed in inches of water. In the orifice meter differential gauge this multiplication is made mechanically and the chart record reads in inches of water.

The float may be placed in either the upstream (high) side or in the downstream (low) side of the gauge. The terms high and low sides refer to the action of the differential pressure upon the tube. By referring to Fig. 6, which shows the flow through the orifice plate, it will be seen that the pressure on the upstream side of the plate is greater than the pressure on the downstream side; this difference is what we mean when we speak of the "differential." This differential pressure is a direct measurement of the force required to "push" the gas through the hole in the plate and it obviously becomes greater as more gas is pushed through. At high rates of flow this pressure may exceed 100 inches of water and then the mercury is blown from the gauge if the checks fail to hold. Obviously, as these pressures act the mercury is displaced in the tube by some amount, "h," the magnitude of which varies with the difference in pressure on the two sides of the plate. As the mercury is displaced the float moves and as the float is linked to the differential pen the pen moves and a record is left upon the chart.

When any movable body is placed in oscillating motion the body will resist any effort to bring it to rest; and further, only very small forces will be required to keep it in motion. This is well illustrated by a clock pendulum. The mercury in the U-tube acts in the same manner, and under the influence of a pulsating flow the mercury will bounce back and forth and leave a very erratic record. In order that this action may be reduced to a minimum the U-tube is provided with some sort of a dampening device to smooth out the movement. Although each manufacturer of meters uses a slightly different device for this purpose, all are fundamentally the same and all act by restricting the flow of the mercury from one side of the U-tube to the other. When any restriction to flow is placed in the U-tube the sensitivity of the meter suffers, so that in general it would seem best not to make use of the dampening devices until it is absolutely necessary. A dampener is of value only on what is best called a fluctuating rather than a pulsating flow, for as the surges come more closely together metering becomes more nearly impossible. You would not attempt to weigh yourself while skipping a rope on the scale platform and neither can you expect to meter gas when the gas is flowing in surges. Considerable research is being done and a solution may be found but for the present it may be said if pulsations are present the gas cannot be accurately metered. Pulsations are not a concern of the operator or chart changer, however, as he cannot control them. The operator or chart changer is, however, directly responsible for the detection of leaks in the piping, the proper zeroing of the meter, and the lubrication of the meter. And in the event of trouble, he should either perform the repairs or make a report of the condition on the chart. The meter should be zeroed before changing the chart in order to substantiate the accuracy of the measurement; this is especially important on 7-day charts.

Leaks may occur in the piping or at the packing glands on the valves, the latter being most often encountered. Another source of leaks is in the pressure-tight bearing. The presence of any leak has a direct bearing on the accuracy of the meter and no leak, however small, should be allowed to continue. As was pointed out above, the differential recorded is the difference in pressure across the U-tube. Inasmuch as this reading is determined by the differential across the plate, if a leak is present the recorded differential is not the true pressure drop across the plate and the metered volume is in error. The hookup is such that a leak on the upstream side of the plate will cause the meter to read low and a leak on the downstream side of the plate will cause the meter to read high through the transmission of faulty pressures to the U-tube.

Lubrication Important

Faulty lubrication may cause several troubles; lack of lubrication gives first a sluggish meter, and then a leaky bearing. Fig. 10 shows the construction of

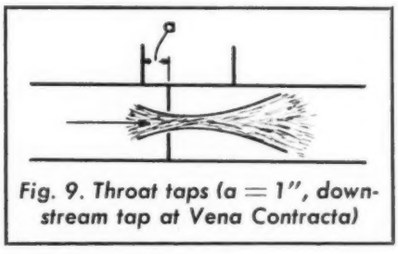


Fig. 9. Throat taps (a = 1", downstream tap at Vena Contracta)

a typical pressure-tight bearing. It will be noted that this bearing is constructed in such a manner that the lubricant serves as a packing about the shaft. This construction makes it doubly imperative that sufficient lubricant be provided, for a leak at this point will affect the accuracy just as much as will a leak in the manifold piping. The effect of a leak at this point may cause a high reading or a low reading depending upon the location of the float in the U-tube. Use of the wrong type of lubricant will result in trouble; too light a lubricant will leak out, and too heavy a lubricant will cause sluggish action.

An excessive amount of lubricant may cause trouble by finding its way into the mercury pots where it will emulsify the mercury. This mercury emulsion is a comparatively light foamy substance, that will affect the mercury levels and consequently the float level leading to a faulty record. The formation of large quantities of emulsion will lead to loss of mercury into the pipe line with a resultant loss of accuracy.

Another source of emulsions is the condensates that drop out of wet gas. The presence of condensate gives more trouble than does lubricant and the two

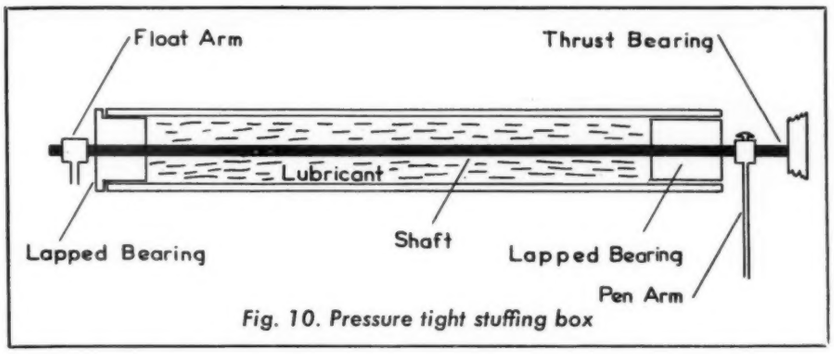


Fig. 10. Pressure tight stuffing box

together mean that the mercury must be withdrawn and cleaned before any reliance may be placed upon the records. The correction of this trouble is outside the chart changer's province and he has satisfied the demands made of him when he reports the condition.

The frequency with which the meter must be zeroed depends upon several factors. If atmospheric temperatures are changing rapidly from day to day as they do in the Spring and Fall the meter must be zeroed to compensate for the change in volume of the mercury. If emulsions are forming and causing mercury to carry over the meter must be zeroed to adjust for this error. Consequently no definite rule may be laid down; in general the chart reader can keep a better check on this and in operations where only a few charts are read the chart reader can call the operator's attention to the condition of the meters. Any interruption of flow will immediately disclose an error in zeroing as the pen will not follow the zero line when no gas is passing. Details of the various steps to be followed in zeroing a meter will be discussed later.

The second of the units comprising the orifice meter is the static spring or pressure gauge. Inasmuch as gas varies in volume as the pressure varies, the measurement would be of small value if the pressures were not known. Webster defines static as "acting by mere weight without producing motion," so we would normally expect the static pressure to remain nearly constant and in most cases it does. The static spring may be of the coil type or for low-pressure work of the simple bourdon tube. In either case the operation and function is essentially the same. If pressure is exerted on the inside of a closed curved tube it tends to straighten and if properly designed the amount of movement of the free end during the straightening will be proportional to the pressure exerted. By proper linkage, therefore, an indicator may be made to indicate the pressure in lb. per sq. in. acting upon the tube. If, as is the case in the orifice meter, a permanent record of pressures is desired, a pen arm and pen may be substituted for the indicator.

In most high-pressure meters the pressure element is of the spring type; that is, a tube shaped into a helix of several turns. This design gives better sensitivity and slightly greater accuracy than does the bourdon tube. In action the helical spring tends to unwind under pressure and the angular movement is proportional to the pressure exerted. By proper linkage this angular movement is transmitted to the pen arm.

Under service conditions these springs will stretch slightly and throw the static pen out of calibration. When this occurs the spring must be recalibrated. Under normal operation this will occur very seldom and a periodic check with an accurate test gauge is all that is required.

Clock Accuracy

The remaining element of the meter is the clock and chart hookup. Thus far we have found that in order to meter the gas two things must be known: (1) the pressure drop across the orifice plate, and (2) the flowing pressure of the gas in the line. And we learned that in the first device that gave this information, periodic readings were required with all the chances for the human error in full effect. In the modern meter a means is provided for making a continuous record of all the changes that occur. With proper care this setup will give results correct within 1 percent of the metered volume. The clock and the time element it introduces are fully as important as the record of the differential and the static in calculating or "reading" the chart. Both the static record and the differential record must be correct in respect to the time element. Suppose, for example, that the static was varying over a large range of pressures as the differential also varied and suppose further that the static and differential records were a half hour or an hour apart in time and no notation was made to indicate this fact. Under such a set of conditions the chart reader might figure the chart but his figure would not be correct, especially for each hourly period. For that reason an occasional check is necessary to insure that the pens have the proper relationship to each other and to the time element. In order to make this point more clearly understood let us assume a set of conditions with exaggerated values of static and differential. Assume the static to be 1000 lb. from 1 to 2 P. M. and 800 lb. from 2 to 3 P. M., etc., and assume the differential to be 100-in. from 1 to 2 o'clock and 50-in. from 2 to 3, etc. The correct pressure extension from 1 to 2 would be $\sqrt{(1000)(100)}$ and from 2 to 3 the correct pressure extension would be $\sqrt{(800)(50)}$. If the pens were not properly set for the time element but were one hour apart with the static leading, the chart would be read so that a pressure extension of $\sqrt{(800)(100)}$ would be taken for the period 1 to 2. It is apparent that large errors would result.

Similarly the chart should be set on the meter at as nearly the correct time as possible and any errors in the clock should be noted on the back of the chart. The clocks are extremely accurate and rugged and require as little work as your watch but they can and do get out of order.

A fast clock will lead the chart reader to believe that the chart was allowed to run over and may result in either a plus or minus error depending on the variations in the flow during the period.

A slow clock like a fast clock can cause inaccuracies in metering if the chart reader is not informed of the condition.

It cannot be overstressed that any condition that may affect the meter must be noted on the chart. The chart changers, or the operators, are at the meter and can see the condition but the chart reader must depend upon them for his information and, however closely he may read the charts he receives, his volume will not check if trouble at the meter is causing the charts to be in error.

The case of the meter protects the clock and the chart from the weather and it must be tight. A chart when damp will swell and get out of round, or if wet, will probably tear out at the hub and cause the record to be lost. Water in the case will also affect the clock so that a close check on the chart cases should be made during wet weather and if the cases are leaking, proper repairs should be made.

EDITOR'S NOTE: This article will be continued in an early issue of *The Petroleum Engineer.*

——☆☆☆——

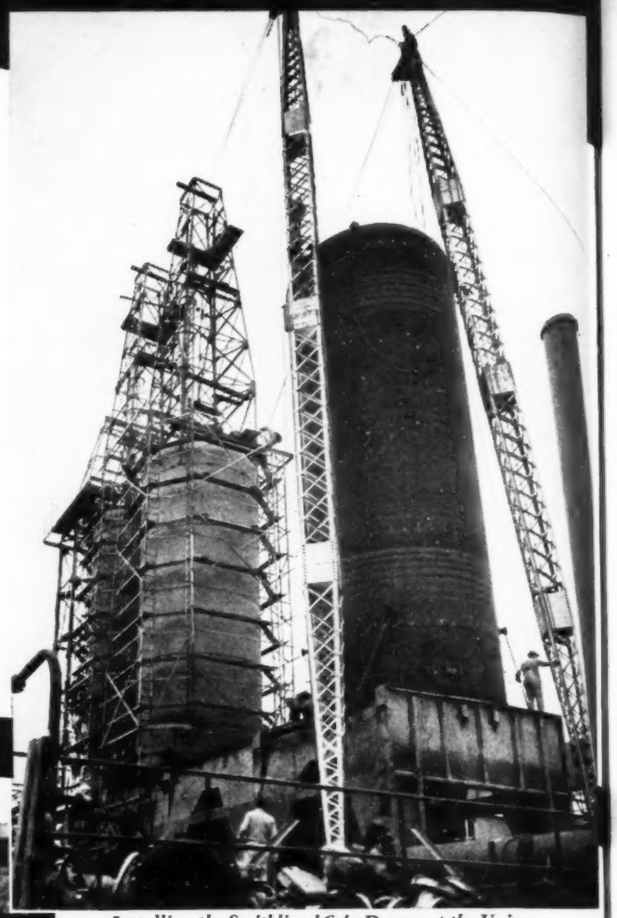
"We Insist on SMITHLINING"

FACED with the need of resistance to specific corrosive conditions at its Oleum (Calif.) Refinery, the Union Oil Company insisted upon *Smithlining.* And so the A. O. Smith Corporation was called on to produce four huge coke drums and six reactors.

These ten Smithlined pressure vessels were so large they could not be shipped in finished form. But size is no obstacle to Smith . . . for no matter how complicated the vessels, Smith facilities are equal to the task. Consequently Union's ten vessels were practically field-built. Under supervision of Smith technicians, the erection contractor—Bechtel, McCone, Parsons Co.—assembled, welded, stress-relieved, and X-rayed the vessels *on the site!*

Cases like this are not unusual . . . for the performance of Smithlined vessels has proved time and time again that (1) Smith-developed testing methods for the selection of proper lining material are *truly representative* and (2) Smith engineering skill and facilities are more than adequate for the fabrication of pressure vessels in accordance with pretested requirements.

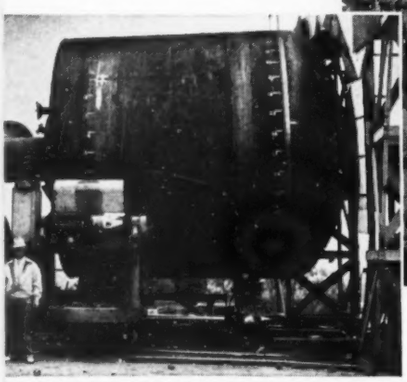
For an *individual* solution to your expansion or modernization problems, ask Smith to tell you how Smith pressure vessels can be Smithlined with various alloys to resist the definite corrosive conditions with which you are confronted. A. O. Smith Corporation, Milwaukee, Wis. Offices at New York, Pittsburgh, Chicago, Tulsa, Dallas, Shreveport, Houston, Corpus Christi, Los Angeles, Seattle.



Installing the Smithlined Coke Drums at the Union Oil Company's Refinery at Oleum, California.

SMITH way

Below: One of six Smithlined Reactors being X-rayed after assembly at Oleum. Size: 15 ft. I. D. x 1¾ inch wall x 29 ft. 7½ inch overall length. Weight of each: 107,000 lb.



View showing field assembling of four Smithlined Coke Drums. Size: 16 ft. I. D. x 27/32 inch wall x 56 ft. 6 inch overall length. Weight of each: 139,100 lb.

DID YOU KNOW?

- That A. O. Smith Corporation was founded at Milwaukee, Wisconsin, in *1874, three years after the great Chicago fire.*
- That during the 67 years of its existence, A. O. Smith has pioneered in new and improved methods of manufacturing steel products with *greater efficiency, greater safety, and increased value per dollar.*
- That A. O. Smith made the *first pressed steel Auto Frame,* originated *modern, dependable Welding,* first produced *welded Pressure Vessels,* and revolutionized pipe line building with *high-strength welded Line Pipe.*

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CORPORATION
Milwaukee, Wisconsin

PIONEER MANUFACTURERS OF ELECTRIC-WELDED

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Refinery Practice for the Operating Man

Vocational Class Proceedings in Refinery Engineering

Cracked Gasolines

Synopsis of Preceding Meetings

The first discussion involved a review of the various hydrocarbons and their thermodynamic qualities as related to the cracking of petroleum and its products. The main hydrocarbons in petroleum and its cracking products are paraffins, olefins, naphthenes, and aromatics. Of these, olefins are virtually non-existent in most crude oils.

Points covered in the discussion included the following: (1) chemical stability of compounds; (2) relative crackability of hydrocarbons; (3) energies released or absorbed in cracking; (4) the decomposition reactions, and (5) effect of pressure on reactions.

In discussing the development of cracking, it was pointed out that the ability of petroleum to crack was discovered by the accidental overheating of a topping shell still, resulting in an unexpected straw-colored distillate, which was in reality cracked distillate.

The importance of clean recycle was first recognized when operators of earlier units discovered that clean stocks permitted longer runs with correspondingly small percentages of gas and coke formed.

Additional gasoline will be obtained if a multiple coil heater is used so that more rigid control from the fractionator will permit separate cracking from the various cuts at optimum conditions. Quenching will be essential to correct control of the time and temperature element.

The excessive heat brought to the fractionator from the reaction chamber can be disposed of in a number of ways: (1) the charge may be used as a quench; (2) heat can be exchanged with the charge to any adjacent unit; (3) the remaining heat must be removed by reflux in the usual way.

The charging stock is less refractory than recycle stock. A cut cracked above its optimum temperature will produce excessive amounts of gas and coke. For maximum gasoline, therefore, it is necessary to separate both the charge and the recycle stock into small cuts. This would necessitate the separate treatment of charge and recycle. These cuts would then be treated at the temperature at which minimum gas is formed and quenched immediately to keep down the formation of polymers and condensation products that reverse the process of cracking and go to form coke. All this procedure would mean many cuts and high recycle ratio. Of course, for practical purposes the above method would have to be modified in order that investment in equipment would be within reason.

When making 70-octane gasoline instead of striving for maximum gasoline yield, a multicoil unit would be used but high reflux ratios would not be feasible for a commercial unit. Ratios from 3 or 5 to 1 were suggested; this would crack the stock deep enough to obtain the desired results. This deeper crack would of course produce a greater percentage of gas and coke, along with many more olefins and aromatics. These compounds tend to make the gasoline more unstable and must be handled accordingly. The conclusion reached was that if modern methods are used the yield of 70-octane gasoline would not be more than 5 to 10 percent less than the maximum yield obtainable.

Definitions concerned with cracking were defined in the following terms: polymerization is the joining of molecules of the same families; condensation is the combination of unlike molecules in a carbon-to-carbon bond with the elimination of hydrogen or water. These two terms come up frequently in the discussion of the chemical processing of petroleum and its products, sometimes in different shades of meaning.

Class Meeting No. 10

(Continued)

NOTE: Throughout the class proceedings, no attempt is made to distinguish the identity of the pupil speaking. When a series of remarks is made by pupils, it usually denotes an interchange of discussion among the class members themselves.

REGARDING poor response to tetraethyl lead, D. L. Yabroff and A. C. Nixon state: "It is well known that the presence of sulphur compounds decrease the octane number and the lead susceptibility. The magnitude of this effect is dependent not only on the quantity of sulphur compounds present, but also on the type. Polysulphides are among the worst in this respect, followed by the disulphides and mercaptans, thioethers, and thiophenes."

Tetraethyl lead reacts with sulphur compounds to form lead sulphide. Lead sulphide is inactive as a knock suppressor. The effect of diethyl disulphide on lead susceptibility of a heptane-octane blend having a 65-octane number is shown as follows:

Sulphur, percent	*Octane No. after adding 3 cc. tetraethyl lead per gal.*
0.00	84
0.20	73

This table appeared as Table 155 on pp. 331 of *Conversion of Petroleum* by Sachanen.

The effect of mercaptans and disulphides is shown in Table 9.

Doctor treating decreases susceptibility due to the trisulphides that are formed. The loss usually is 0.5 to 3.0 numbers.

The latest data of Schulze and Alden are of particular interest with reference to the effect of small amounts of sulphur on lead susceptibility. A Borger, Texas, natural gasoline, containing 0.037 percent sulphur, was desulphurized to 0.008, 0.004, and 0.002 percent. The octane numbers and lead response of the initial and desulphurized gasolines are as follows:

Percent sulphur:	*Initial* 0.037	*Desulphurized* 0.008	0.004	0.002
Clear	67.2	69.5	69.6	69.7
1 cc. tetraethyl lead	75.6	80.0	81.0	81.4
3 cc. tetraethyl lead	82.1	85.3	86.8	87.5
6 cc. tetraethyl lead	86.6	91.2	92.8	93.2

These figures show clearly that the desulphurization of gasolines to the minimum sulphur content is of importance in producing high-octane number fuels.

Pre-ignition causes a decrease in octane number and as sulphur compounds ignite easily, the heat of compression causes a precombustion.

Thiophenes have the least effect on the effectiveness of lead; i.e., the heat stability of sulphur compounds is a good indication of the effect on lead susceptibility. During doctor treatment, less harmful mercaptans are often converted into disulphides and polysulphides.

Leader: Are there any questions that any of you wish to ask on this subject?

Pupil: The statement was made that mercaptans gave a negative test with doctor and copper strip. Isn't it a fact that the higher molecular-weight mercaptans do not cause corrosion on copper strip? I think that is probably true.

Leader: My opinion is that all the mercaptans present will contribute to a poor strip test. From the viewpoint of the customer, I believe the corrosion test is very important. The customer doesn't know what corrosion test is. It would scare him to death if you told him about it. I remember one man who was a refinery worker and who later operated a filling station, and a certain customer came in. He had something that looked like gum on the outside of his carburetor and he asked the filling station operator what it was. The fill-

TABLE 9

Compound added	Amount as sulphur, percent	Octane number of gasoline	Octane number with 1 cc. tetraethyl lead per gal.	Lead response per 1 cc. tetraethyl lead per gal.
None	0.000	50.8	63.7	12.9
Methylmercaptan	0.044	49.8	58.9	9.1
Methyldisulphide	0.050	49.9	58.9	9.0
Ethylmercaptan	0.042	50.0	58.9	8.9
Ethyldisulphide	0.043	50.1	59.1	9.1
n-Propylmercaptan	0.040	49.9	58.9	9.0
n-Propyldisulphide	0.038	49.9	58.8	9.1

This table appeared as Table 156 on p. 331 of *Conversion of Petroleum* by Sachanen.

ing station man replied with no hesitation that it was gum. The customer said, "What is gum?" and from there it went into a semi-technical discussion that scared the man so that he went to another filling station from then on.

Pupil: They have systems for treating crude oil now before it is processed. Can they reduce the total sulphur to the allowable limit before distillation begins? The only pre-treat I have seen for crude oil is to remove hydrogen sulphide so it won't corrode the equipment, but you still have the free sulphur and other sulphur compounds present.

Leader: I do know of some refiners who have treated the crude oil quite heavily and have made a relatively sweet oil, but I don't know of anyone doing it right now.

Next in order is to have a discussion of doctor treatment of cracked gasoline.

Pupil: Doctor treatment is the treatment of gasoline with sodium plumbite and sulphur. In the early days all gasoline was doctor treated; that was one of the earliest and most widely used treatments and it wasn't much of an expense item because the margin was wider and a few cents per bbl. treating expense wouldn't make much difference. They used lots of doctor and lots of lead and threw it away when it was used, but with progress coming in refining, the margin was cut down; they came along with octane numbers and lead susceptibilities, inhibitors, etc., and doctor treatment became the subject of much study. Doctor treating seemed to reduce octane number as well as tetraethyl lead susceptibility. Gum became a problem and the inhibitors used further increased lead requirements. The problem was to get a system that could be used to reduce the cost and improve the response to the different tests.

Sodium plumbite is a mixture of lead oxide (litharge) and sodium hydroxide (caustic soda). As soon as the sodium plumbite was used once, the original method was to throw it away and add more lead and caustic to build up the doctor solution again, but now they regenerate the doctor solution and use it over and over. The reactions in doctor treating may be expressed as follows:

$$2\,RSH + Na_2PbO_2 \rightarrow (RS)_2Pb + 2\,NaOH \quad (1)$$

$$RSH + NaPbO_2 \rightarrow RS-Pb-ONa + NaOH \quad (2)$$

$$(RS)_2Pb + S \rightarrow PbS + RS-SR \quad (3)$$

R-S-S-S-R R-S-S-S-R R-S-S-S-R

S S△S

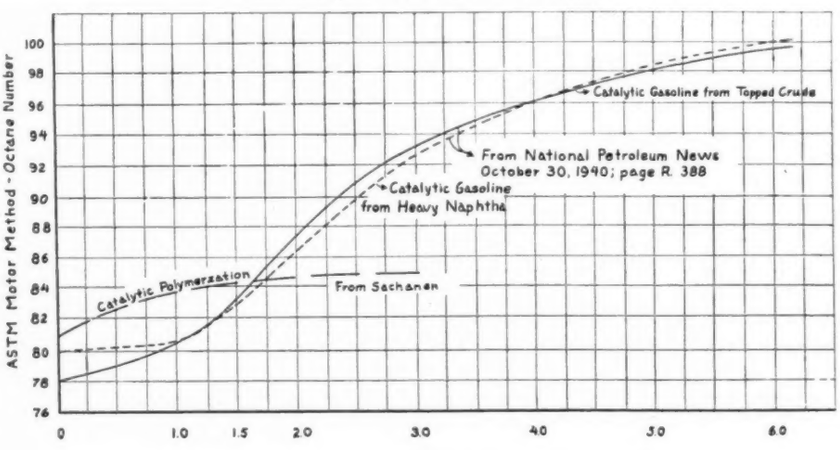
First, in treating the gasoline, no sulphur whatever has been removed from the gasoline unless it is the sulphur in the hydrogen sulphide. In equations (1) and (2) the mercaptan reacts with sodium plumbite, resulting in mercaptides and also the other reaction of the mercaptides with the sodium plumbite. There are two different forms here—they are more or less theoretical, but that is what the reactions are thought to be. Equation (3) shows the mercaptides with the sulphur forming the lead sulphide and alkyl disulphides. There are numerous other reactions, giving possibly disulphides, trisulphides, and other polysulphides that are undesirable. In the early treatment with doctor, disulphides, trisulphides, tetrasulphide, and pentasulphide were formed but with controlled treatment they can be reduced possibly to trisulphides and disulphides.

If the doctor solution and sulphur is withdrawn from the treated gasoline and allowed to settle, it will divide into three layers: lead sulphide; unused plumbite, and another layer of gasoline and lead sulphide, usually known as the "black strap".

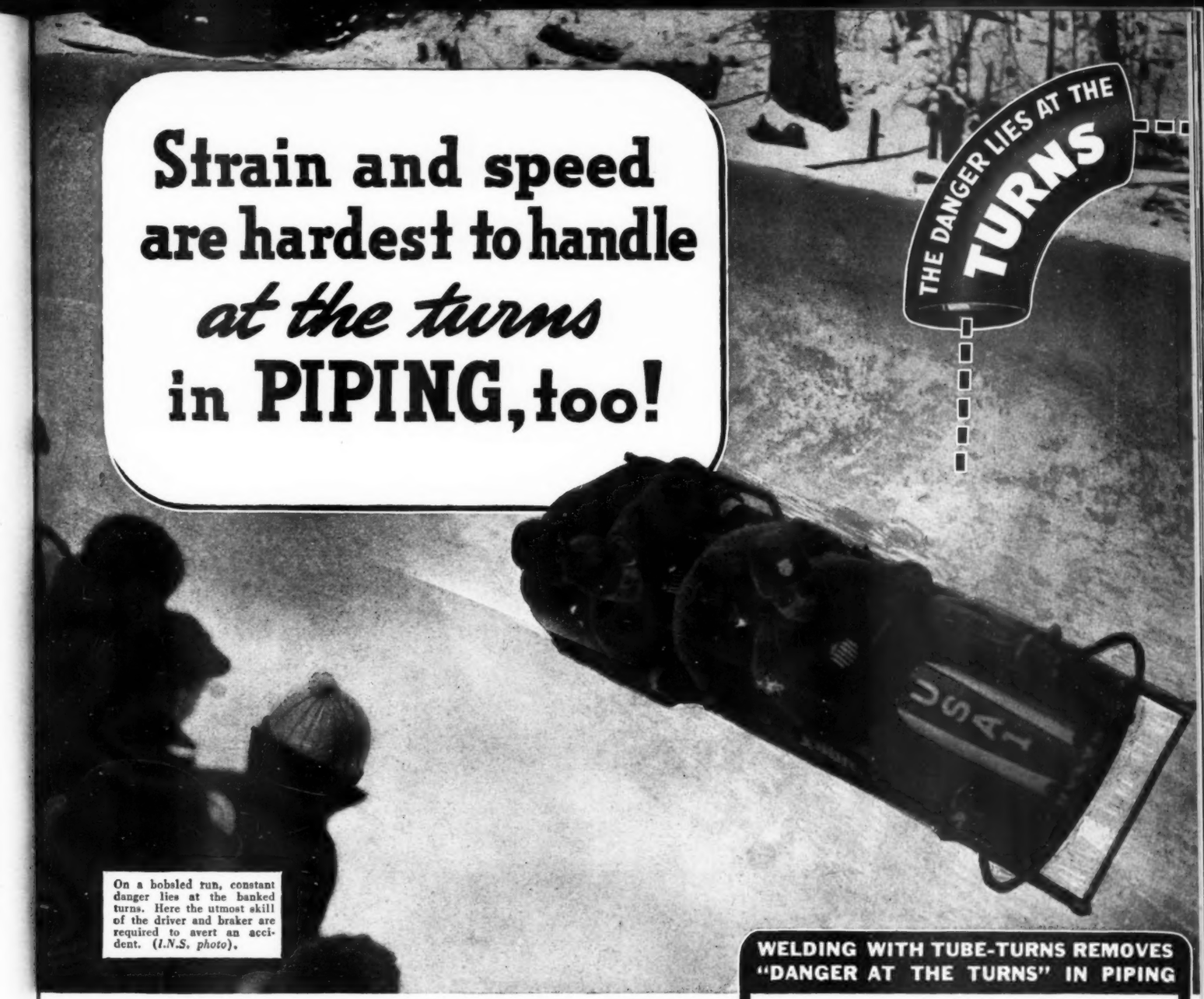
The mixture of gasoline and lead sulphide causes trouble in regenerating the doctor solution. Usually the refiner puts it in an open tank and blows it with air. If it is blown with air, the gasoline breaks down and forms a gum and makes the lead sulphide unusable with further doctor solution. That was one of the first ways they treated it, by blowing with air. Another method of breaking black strap is the addition to it of spent caustic containing sodium sulphide until all the lead has been precipitated as lead sulphide. Heating and circulating a tank of black strap after this addition will liberate the gasoline, which may be drawn off and separated from the caustic layer, now free of lead. This may be used as a caustic wash, leaving the recovered lead sulphide to be made into doctor with fresh caustic solution. The process has the added advantage of eliminating a portion of the caustic layer, which carries with it salts and other impurities such as tar acids that tend to build up in the doctor solution with frequent regeneration. In the treatment of gasoline with the doctor solution, there are optimum conditions as with everything else.

The octane number is lowered by the presence of sulphur compounds such as the trisulphides, tetrasulphides, and pentasulphides, and the disulphides to some extent. But these can be kept at a minimum by controlling the amount

Lead susceptibility of various gasolines



Strain and speed are hardest to handle *at the turns* in PIPING, too!



On a bobsled run, constant danger lies at the banked turns. Here the utmost skill of the driver and braker are required to avert an accident. (*I.N.S. photo*).

Insure safer, stronger, trouble-free piping systems with TUBE-TURN welding fittings

When the fluids or gases in your piping systems zoom through the lines and swerve into the turns—*added* strain and friction strike the fittings and joints. Trouble usually develops here *first* in any piping system *because the most danger lies at the turns!*

Weld with TUBE-TURN fittings and *your* plant piping systems will last far longer, function more efficiently and safely, save valuable space, and cut upkeep costs.

There is a TUBE-TURN for *every change in flow direction*—elbows, returns, tees, reducers, laterals, nipples and flanges—made with Tube-Turns' exclusive forging process to give unequalled reinforcement at these danger spots.

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Welding ★ The ★ FIRST WELDING FITTINGS 1ST AND STILL THE BEST *Fittings*

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which enable Petreco to provide the oil industry salt removal percentages that really pay off. Because of this Petreco protection, refinery units are operating with fewer shutdowns than ever before. Mechanical failures due to corrosion, high maintenance costs that result from plugging, and expensive ammonia treatments, all are refinery expenses that are being reduced or eliminated by Petreco desalting.

Because of Petreco's nation-wide service organization, there is a representative near your refinery who will go over your salt problem with you. Petreco laboratories are available to you for accurate tests and performance predictions on your charging crude. The Petreco engineering staff is ready to submit proposals outlining installation and operating costs. Avail yourself of these Petreco services now. No obligation is involved.

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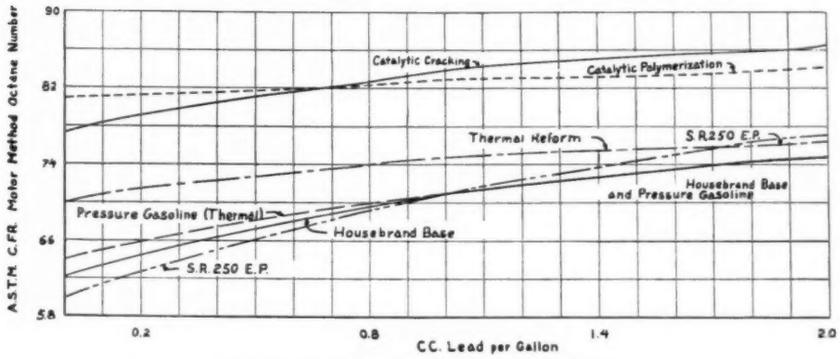


Lead susceptibility of catalytic gasolines

of sulphur used to break the lead sulphide from the gasoline. It has been shown that you can get a gasoline from the doctor treatment that is sweet and not corrosive, yet the lead response is very poor. A gasoline may be doctor sweet and noncorrosive, but it may contain sulphur compounds that have a very high sulphur content, probably higher than some corrosive gasolines.

"A clear distinction should be made between octane loss *per se* and decrease in lead susceptibility. Doctor sweetening, improperly carried out, can cause serious loss of octane number, running to as high as 3 points. In our experience, however, the manner of doctor sweetening does not affect lead susceptibility, defining this as the increase in octane number per cc. of lead added, nor have we found any significant difference between the lead susceptibility of doctor-sweetened gasoline and that sweetened by other methods."[3] In that case, it appears that the disulphides would not have any effect on lead susceptibility, so the optimum condition of doctor treating is to form nothing but alkyl-disulphides. "That high octane loss through doctor sweetening has been so generally tolerated, has come from the generally accepted idea that, if a gasoline was sweet and non-corrosive, its treatment left nothing to be desired. When these have been the only criteria, octane loss has varied from about ½ to 3 octane numbers depending largely upon the sourness of the gasoline. But a fundamental discovery is the fact that gasolines may be sweetened with a great excess of sulphur and yet be non-corrosive. To understand why this occurs, it is necessary to go a little into the chemistry of sweetening. The reaction of doctor solution with the mercaptans of gasoline gives rise to lead mercaptides, which are then converted into organic disulphides and lead sulphide, by the addition of sulphur. At least we fondly hope that this is the reaction, and the only reaction that goes on. But as most of you know, if you shake a sample of gasoline with doctor solution and then slowly add sulphur, it becomes almost every shade of orange or brown before breaking down to give the black precipitate and clear gasoline. This orange color appears to be due to the intermediate presence of sulphur in polysulphide form in a complex compound containing lead, an alkyl radical, and sulphur. If the amount of sulphur used is kept to a minimum and the break is slow, these polysulphides break down to disulphides and lead sulphide, although probably this reaction is never exclusively the one occurring and traces of polysulphides are usually left in the gasoline. The extent to which these polysulphides remain after sweetening depends upon the mercaptan content of the gasoline and the amount of sulphur used. Often a large excess of sulphur, as much as three or four times the theoretically necessary amount, may remain in the gasoline as polysulphides. Because this sulphur is not present as atomic sulphur, it does not affect the ordinary copper strip corrosion test and its presence is often not suspected, although it is extremely harmful to octane rating and inhibitor susceptibility. Some of these polysulphides have been produced synthetically in the laboratory and their harmful effect on octane number proved by their addition to gasoline. Polysulphide formation can be reduced:

1. By careful control at all times, of the amount of sulphur added. This is facilitated by use of an accurately controllable sulphur valve, and tests for excess sulphur made by the treater during operation of the plant with mercury or butyl mercaptan.
2. By adding the sulphur after the doctor solution and gasoline have been thoroughly mixed, and providing adequate mixing following sulphur addition, to speed up the break and promote settling of lead sulphide. This mixing may be obtained by baffle columns or special mixers. Mixing time of one minute is about a minimum, and it is often advantageous to increase it beyond this period. This can best be done by a mechanical mixer. Proper mixing, in most gasolines, allows excess sulphur to be kept to one or two thousandths of one percent. In an average gasoline, one hundredth of one percent excess sulphur may cause an octane loss of a full number.
3. By treating at a temperature above 80°F., which accelerates the break and aids settling. We are studying use of temperatures higher than this, but have not completed the work. There is indication that temperatures as high as 120°F. may have no harmful effects and the elevated temperatures appear to be beneficial. High temperature of treating does not, however, eliminate any of the harm done by poor sulphur control.
4. By providing adequate settling, so that the lead sulphide may be removed from the gasoline without tempting the treater to step up the sulphur to obtain a clear product.
5. When mixing and settling alone will not give a clear gasoline—as is often the case with gasolines containing high boiling mercaptans, which break slowly and do not settle well, by providing a second contact with doctor solution or caustic (no more sulphur), further settling; and a sand filter or a water wash to remove the last traces of haze from the gasoline.

"If these precautions are observed, and minimum sulphur used in sweetening, the octane loss can in nearly every case be reduced from 0.2 to 0.5 numbers depending upon the sourness of the gasoline.

"We are conducting research on methods of doctor sweetening which may give still lower octane loss by eliminating all traces of polysulphides."[1]

These polysulphides that are detrimental to the octane number also give a poor inhibitor response. It is supposed that they react very much as the peroxides do to form gum and consequently if the polysulphides are kept at a minimum, the inhibitor susceptibility will be good. Some costs on doctor sweetening are given as follows:

Total cost . . . $0.0062 per bbl.
Chemical cost . . $0.0021 per bbl.

Thus the chemical cost amounts to about one-third of the total cost. The other elements of cost follow:

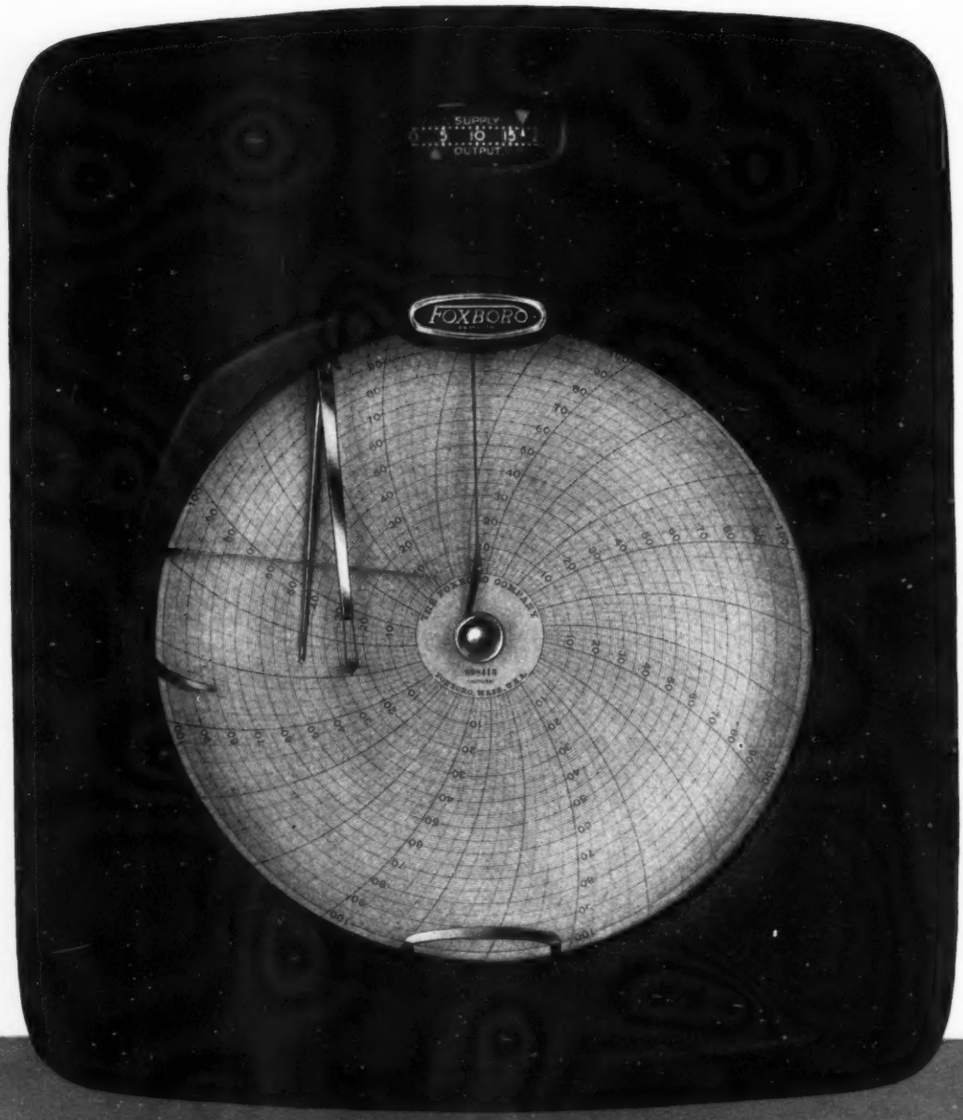
(*Continued on Page 60*)

[1]From pamphlet by Chas. Lowry, Jr., published by Universal Oil Products Co.

MODEL 30

Stabilog Controller

REG. U.S. PAT. OFF.



Advances in Model 30 Stabilog Controller include this distinctive new case. It sets a new high standard of functional beauty in flush-mounted rectangular case design.

For Temperature, Pressure, Flow or Liquid Level

SIMPLIFICATIONS — not complications PROVIDE ITS ADVANCED EFFICIENCY!

Typical of many Foxboro refinements is the single, quick-reading dual-indicator to replace two separate pressure gauges.

• • •

It's not a matter of added gadgets, but carefully-engineered simplifications, that makes the Model 30 Stabilog Controller a revolutionary advance in stabilizing control. This new instrument incorporates mechanical refinements never before employed to eliminate friction, lost motion and possibilities of human errors in controller operation.

Surer, Easier Manipulation

Even secondary elements such as air-pressure gauges have gained added utility through simplified design. In the Model 30, an exclusive new dual pressure indicator replaces the two separate gauges usually employed in air-operated instruments. At a glance, both supply and output pressures are instantly read on the compact edgewise scale.

Throttling range and reset adjustments, too, are simplified to permit speedy, accurate setting. They're readily accessible to authorized instrument men, but safely locked against tampering.

Vital Interior Refinements

Eleven years' experience with over 10,000 installations have revealed no need for fundamental changes in the original Stabilog Control principle. Yet, many additional refinements throughout the mechanism of the new Model 30 Stabilog Controller reduce friction and lost motion even further . . . increase sensitivity and response to a degree that enables use of smallest, most efficient proportioning band values.

Get Full Details

These are only a few "high lights" of the new Model 30 Stabilog Controller. For detailed description and discussion, write for Bulletin A252. It explains why Model 30 is attracting widespread attention in process industries by its smoother, closer control. **The Foxboro Company, 130 Neponset Avenue, Foxboro, Mass., U. S. A.**

Creative Instrumentation

by FOXBORO

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(Continued from Page 57)

	Cost per bbl.
Operating labor	$0.0014
Operating supplies . . .	$0.0003
Power	$0.0003
Maintenance labor . . .	$0.0012
Maintenance material . .	$0.0009
Total	$0.0041

So the other five costs are relatively small compared to the chemical costs.

Pupil: Is that the cost of treating Mid-Continent stock?

Pupil: Yes, that is the yearly average. There is another cost that is not shown and that is the gasoline loss, which amounts to 0.25 percent.

Pupil: Is that treating cost based on the total gasoline, the straight-run gasoline, or pressure gasoline?

Pupil: The total gasoline; the treating cost on the straight-run gasoline is considerably less.

Leader: Are there any questions?

Pupil: Was the statement made that the cost of treating straight-run gasoline is less?

Leader: Yes, it should be less.

Pupil: How do those costs compare with butane-pentane doctor treating?

Leader: Butane-pentane costs are higher than that.

Pupil: Is it correct that in doctor treating, no sulphur is removed from the gasoline.

Pupil: That's true.

Leader: Essentially no sulphur.

Pupil: I wanted to take issue in that respect. In Kansas crude runs, there is a high sulphur content. When such crude is sweetened with doctor there still is corrosion due to sulphur, but if you blend that with pressure gasoline having a high mercaptan content, then the blend will be doctor sweet and non-corrosive, so somewhere the sulphur is getting out of the gasoline.

Pupil: Sachanen, on page 338, says the total content of sulphur usually is not changed by sweetening.

Pupil: The remark concerning Kansas crude gasoline is correct, except that when sweetening without the addition of doctor, you have practically no lead sulphide formation.

Pupil: There is a chemical reaction. You take one gasoline with free sulphur and another with mercaptans. They will react and form disulphides, causing the blend to become sweet and non-corrosive.

Pupil: It will reduce the sulphur content but not free sulphur content.

Leader: I had an argument with a chemist some time ago in which I maintained there was a slight removal of sulphur, so we surveyed several hundred samples and when we finished, the values were something like this:

0.050 before doctor treatment.
0.048 after doctor treatment.

I hope that you will remember that these polysulphides are the compounds we do not want and that their formation is the weakness of doctor treating.

Pupil: There is one question I should like to ask: Doctor treatment reduces the octane rating 3 whole numbers, but it was stated that it might not affect the lead susceptibility. Is that the lead susceptibility before doctor treating or the new octane number?

Leader: The only way the lead susceptibility can be affected would be by the use of excess sulphur. If the treatment were carried out under optimum conditions and wouldn't cause a loss of one-half octane number on the treatment, then the lead susceptibility would be as good after treating as it was before treating, but if the octane number has decreased any more than, say, 3 octane numbers on the treat, then the lead susceptibility would decrease.

Pupil: I have read that doctor treatment is always advisable and that it still is very good for some types of gasoline.

Pupil: According to one reliable source of information, doctor treatment is still used for treating a larger volume of gasoline than any other process on the market.

Leader: The next type of treatment to be discussed is the copper chloride treatment of cracked gasolines.

Pupil: The copper chloride treatment is the process developed by Phillips Petroleum Company. Before I give the flow, the chemical reaction may be described as follows[1]: "The mechanism of the reaction of mercaptans with copper sweetening solution is essentially the oxidation of the mercaptans to the corresponding disulphides and the reduction of the cupric ion to the cuprous state. Exemplified with a cupric chloride solution, the reactions are as follows:

(1) $4\,R\text{-}S\text{-}H + 2\,CuCl_2 \rightarrow R\text{-}S\text{-}S\text{-}R + 2\,R\text{-}S\text{-}Cu + 4HCl$
Mercaptan; Cupric chloride; Disulphide; Cuprous mercaptide; Hydrochloric acid

(2) $2\,R\,S\,Cu + 2\,CuCl_2 \rightarrow R\text{-}S\text{-}S\text{-}R + 4\,CuCl$
Cuprous mercaptide; Cupric chloride; Disulphide; Cuprous chloride

Combining the two stages, the equation becomes:

(3) $4\ R\text{-}S\text{-}H + 4\,CuCl_2 \rightarrow 2R\text{-}S\text{-}S\text{-}R + 4\,CuCl + 4HCl$
Mercaptan; Cupric chloride; Disulphide; Cuprous chloride; Hydrochloric acid

"Cuprous chloride formed in the reaction, although practically insoluble in water, is quite soluble in solutions containing a high concentration of chloride salts. The hydrochloric acid is retained also by solution. These two factors are highly essential to the process since in the next step the cuprous chloride and the hydrochloric acid are reconverted to cupric chloride by oxidation with air. The equation for this reaction is:

(4) $4\,CuCl + 4\,HCl + O_2 \rightarrow 4\,CuCl_2 + 2H_2O$
Cuprous chloride; Hydrochloric acid; Oxygen; Cupric chloride; Water

"Addition of equations (3) and (4) gives the simple expression:

(5) $4\,R\,S\,H + O_2 \rightarrow 2\ R\text{-}S\text{-}S\text{-}R + 2\,H_2O$
Mercaptan; Oxygen; Disulphide; Water

from which it is seen that no chemicals, other than oxygen, which in practice is obtained from compressed air, are used up in the process."

In the processes as given by Phillips, there is a choice of two processes: (1) the liquid and (2) the solid, which employs copper sulphate and sodium chloride. In the liquid process, sour gasoline is first contacted with chloride in a centrifugal pump to remove the free sulphur present. It is not necessary to use that—you can go right on to the copper solution. The copper solution is introduced into the stream and the spent solution is dropped back into the regenerating tank and regenerated with air and the air is diffused into particles and goes into the solution and the regenerating tank is allowed to overflow into the solution tank. In the sweet gasoline stream coming out, there is often free copper present, which is detrimental to the storage stability of the gasoline. That is removed by a solution of sodium sulphide which may be allowed to settle and then used over and over. In the solid process, the copper sulphide is mixed with a medium of clay or any filtering medium. The sour gasoline is treated with caustic solution the same as in the liquid process. The air is introduced into the gasoline stream before going to the copper reagent tank to cause the gasoline to regenerate constantly. The copper chloride and the sweet gasoline run to storage from there.

EDITOR'S NOTE: This series will be continued in an early issue.

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Valves—Their Selection and Application

PETROLEUM ENGINEER Exclusive Feature

☆ A review of the essential differences between gate and globe valves designed to improve the service derived from this important class of piping control

by F. E. Davenport
Crane Co., Chicago, Illinois

ENGINEERS, shop superintendents, maintenance men, and others who are responsible for the proper operation of industrial piping systems, must be conversant with the many components of the entire system — boilers, turbines, pumps, filters, regulators, heaters, condensers, etc., and, of course, piping, valves, and fittings. Improper functioning of any one of these units will seriously impair the efficiency of the whole. Although each unit is important in itself, the controlling devices that govern the flow of industry's life-giving streams of steam, water, gas, air, oil, etc., stand second to none. Among such controls, valves deserve increased study and attention, not only because of their functions, but also because of their numbers, some systems requiring hundreds, even thousands.

In these times of unprecedented demands upon industry, it seems fitting to turn the spotlight on valves with the hope of helping operators of piping systems obtain maximum service from their valve equipment.

It would be presumptuous to assume that experienced operators are unfamiliar with this subject; but it also must be admitted that even the best of them, being human, are often likely to take too much for granted or even forget what they once knew so well. Then, there are the new men in the field, who, by choice or circumstance, find themselves in industrial environments in which they are required to select and operate valves, often with an inadequate knowledge of this important phase of their work.

It is not the purpose of this article to cover all details of valve construction, design, and characteristics, but rather to bring out the more or less fundamental aspects of valves in common use. For that reason, emphasis will be given to gate and globe valves, the two types most frequently used in piping installations.

Characteristics

In choosing between a globe and a gate valve for a particular application, basic characteristics of the valves must be considered. A gate valve is essentially a stop valve, nothing more. It is meant for "wide open" or "tight shut" service. There should be no intermediate control, commonly called "throttling", as it is obvious that the increased velocity of the fluid passing through a restricted opening will cause an erosion of the disk-seat surface. This action is know as "wire-drawing", and produces but one result—a leaky valve.

F. E. DAVENPORT

is a sales engineer, Valve and Fitting Department, Crane Co.—Prior to joining the Crane organization several years ago, he gained extensive experience as an industrial sales engineer and technical advisor in chemical, metallurgical, and mechanical engineering.

Gate valves present little opportunity for fluid entrapment, thus lending themselves to almost complete drainage as a safeguard against damage by freezing in water lines or plugging from hot fluids that solidify upon cooling. Inasmuch as disk operation in a gate valve under pressure is across the flow, with no action directly against pressure, it is possible to operate any size.

On the other hand, a globe valve is a control valve. It is designed as a device to regulate flow anywhere from a trickle to a full stream. Flow changes direction about six times in passing through a globe valve and this sets up tremendous turbulence and creates high pressure drop. In fact, pressure drop through a globe is about 60 times that through a gate of the same size. Usually this is not too serious, the desire for minute control being more important than full quantity flow.

Disks in globe valves are especially resistant to erosion or wire-drawing, the degree of this durability depending upon the design of the disk-seat arrangement. Because of the great pressure exerted by flow upon the face of the disk, globe valves are definitely limited in their feasible size because of the difficulty of operation. To be specific, globes vary in maximum size inversely as the operating pressure class increases. Low-pressure globes (125-lb. steam) are made as large as 16-in. whereas high-pressure (1500-lb. steam) valves are generally held within the 6-in. limit. Ease of operation may be obtained by a sensible use of bypass valves to equalize high and low side pressures on the disk, thus making operation simply a matter of mechanical movement of the parts.

If consideration is given to the above, it is evident, therefore, that the best type of flow will be had from a gate valve as the passage through it is virtually full nominal pipe size and, especially in valves with seat rings recessed flush with the port surfaces, there is a minimum of turbulence created, hence the lowest possible friction loss or pressure drop.

Differences

Gate. Gate valves are commonly made with three different disk seat arrangements. There is, first, the solid wedge disk with the corresponding angle seats. This type of valve is recommended for general service for such fluids as steam, water, oil, air, and gas. These valves may be installed with the body or the stem in any position and will give excellent performance provided they are not subjected to excessive transverse stresses caused by an improper support of connecting pipe lines or equipment. Inasmuch as the disk has fixed face-to-face dimensions, any force

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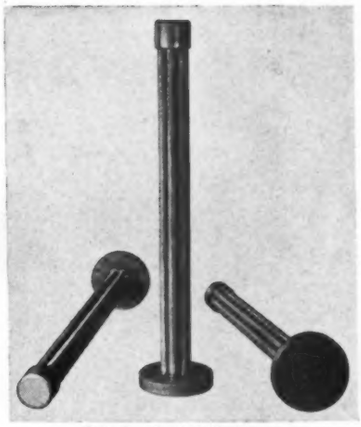

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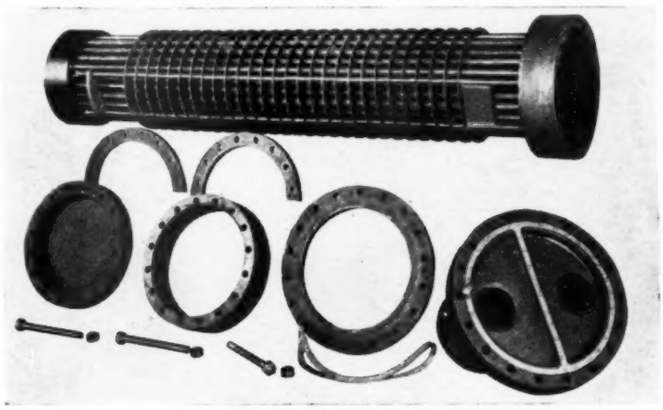

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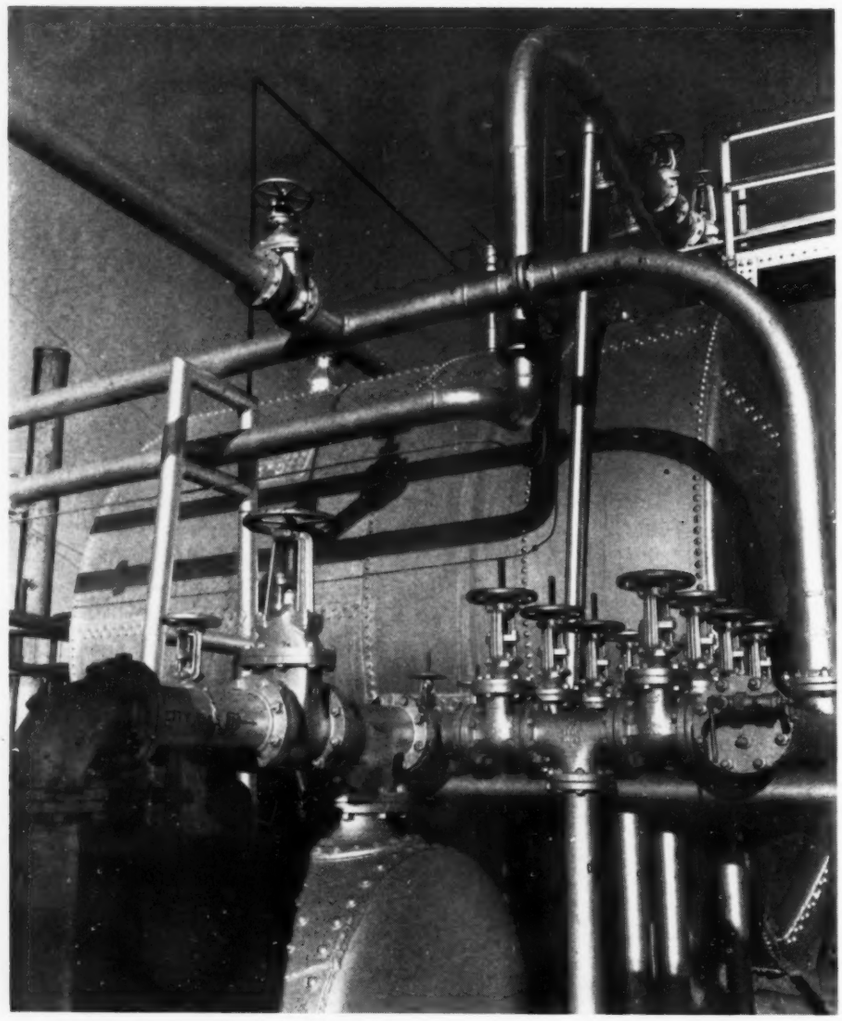

Welded piping installation

tending to distort the body might alter the proper angle between the faces of the seat rings and cause a leak by destroying proper disk-seat contact.

The second type of gate is known as the split wedge. This means that the two faces of the disk are separate pieces and are forced into a proper closing position by a suitable spreading arrangement between them that is actuated by pressure from the stem as the valve is fully closed. Conversely, in opening, the spreading pressure is removed first, permitting the two disk halves to collapse or retract slightly from the seat rings before the disk begins to rise. From the name, it is understood that split wedge disks have a tapered contact between disk and seats. This angle is approximately the same as in solid wedge gates; in fact, the split wedge disk is sometimes used as a replacement in solid wedge type valves especially if the angle of the seats has been slightly altered by distortion. It is easily understood that any change in seat angle, if not too pronounced, is readily followed by a split wedge disk and a tight closure maintained.

The third type of gate valve is the double disk with parallel contacts between the faces of the two disk halves and their respective seat rings. This type of valve offers the advantages of economical manufacture and repair because the disk seat contact faces are at right angles, in all positions, to the centerline through the run of the valve. No special eccentric equipment is needed either to make or to regrind the seats.

Unlike the solid wedge disk, double disk valves are recommended for liquid service only because of the tendency of the disk mechanism to chatter under certain conditions of flow such as high velocity, especially when the valve is in steam service. The spreader mechanism is effective in all directions thus giving unusual flexibility to the closing effectiveness of the disk. Valve distortion due to excessive line stresses is compensated for, within reasonable limits, by the ease with which this type of disk lends itself to seat angle changes. It is important, however, that the valve be kept in an upright position with the stem approximately vertical, especially in service where suspended matter or fluid contamination of a gummy nature tend to deposit or settle out, as the spreader arrangement may become jammed and make it impossible to operate the valve.

Globe. Globe valves are divided into at least four distinct types by reason of the disk-seat design. The common, or conventional type is the ball disk, which closes against a beveled seat ring in what is essentially a ring-line contact. Because of this line-contact, only a moderate amount of throttling is advisable as there is a great probability that wire-drawing will be induced, destroying this line contact by erosion. This type of valve is suitable, however, for general service because it is relatively easy to repair or regrind the seat, thus restoring the original tightness. A low manufacturing cost is reflected in a corresponding low sale price.

The next type in this class is one that has been widely accepted as a general utility valve. It has a flat disk that is easily renewed with a wide choice of materials suitable for a variety of services. These disk materials are principally various compositions that are softer than the valve metal itself, and, for this reason, require less effort for a tight closing. In the event foreign matter becomes caught between the seating surfaces, the closing pressure will imbed it into the disk face and still assure leakproof operation. Obviously, disks of this description do not lend themselves readily to a throttling service. Disk breakdown is promoted by erosion and valve failure is fairly rapid.

The third type of valve, normally classed as a globe, is the needle valve. As the term implies, flow through this valve is of maximum restriction. This valve is designed especially for fine throttling control, such as in oil burner installations, where minute, accurate flow is desired.

The fourth type is the plug type valve, so called because of the broad contact between the disk and seat. This design presents the greatest single advance in valve construction to date. The arrangement of the disk and seat is best compared to a ground glass stopper in a perfume bottle. The contact between the stopper and the bottle neck is a wide, perfectly ground fit. In a plug disk valve, this broad flat contact lends itself perfectly to the most severe conditions of flow control. Extended and unusually severe throttling is successfully combated even in such applications as drip and drain lines, boiler

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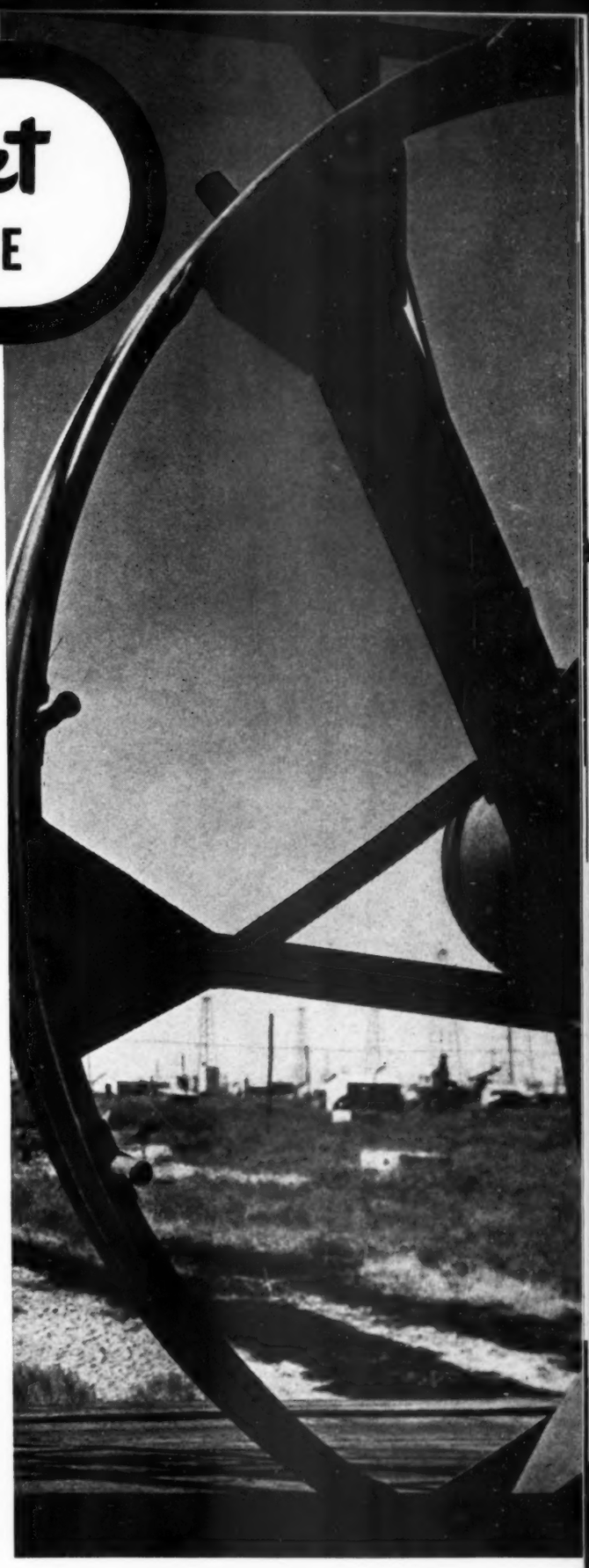

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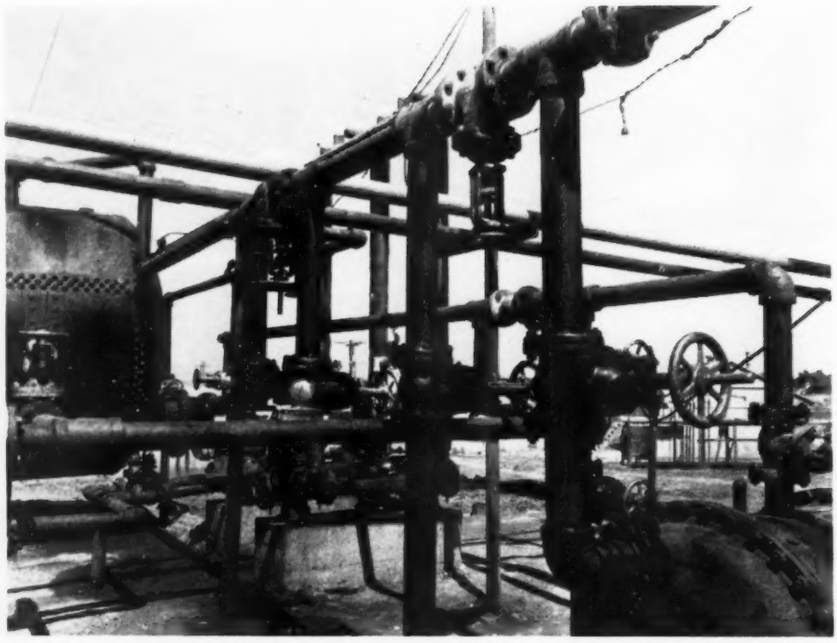


Reflux lines from tubestill to reflux vessel in refinery

blowdown or soot blower services, and engine or pump throttling control. This performance is due to the flow being spread out in such a thin, uniform sheet that concentrated impingement on any one spot is virtually impossible. Should foreign matter nick the contact surfaces during the act of closing, the remaining area is usually sufficient to preserve tightness.

It is obvious that with the disk extended into a plug form, a constriction of the seat opening will result. To some, this may appear to choke the flow and reduce the output. Strangely enough, just the opposite is true. By extending the seat ring to balance the plug, a venturi is created that actually accelerates flow to an output equivalent to that of a valve with nominal size seat opening. Under certain conditions, the flow is actually greater than nominal.

Another advantage of the plug type disk is that for every successive turn of the handwheel from closed to open position, the annular area between the plug disk and the seat increases in equal increments, thus giving true straight-line flow. This is especially valuable to the operator who wishes to calibrate valve flow.

Seats

Seat rings are usually confined to two common types—back seated and shoulder type. There has been much discussion concerning the relative merits of these two types. The former relies upon a tight contact between the bottom of the ring and the body metal, whereas the latter depends for tightness upon a tight contact between the back of the shoulder flange and the body metal. Although both types are in use, it is probable that the shoulder ring offers greater advantages. The principal advantage is in the greater diameter of shoulder to keep the ring from unscrewing and also the greater area of the back of the shoulder in contact with the body metal. This area, together with the lock washer action of the shoulder when the ring is screwed up tight, resists both loosening of the ring as well as leakage past the threads on the back of the ring.

Stems

In gate valves, it is generally known that rising and non-rising stems are available. Of the former, there are the inside and outside thread types. The inside thread is protected from outside corrosion or other damage; the outside thread, known as the O. S. & Y. type, protects the threads from the danger of corrosion within the valve. If there is sufficient head room, the rising stem acts as an indicator to denote the position of the disk. But users are cautioned to protect the stem from injury if in an exposed position because a rising stem that is bent becomes inoperative.

Rising stems of the inside thread type turn with the handwheel; the O. S. & Y. stems do not turn but rise through the handwheel. The single exception to this is the O. S. & Y. clamp gate valve in which the stem turns, the handwheel rising with it.

Non-rising stems are, of course, of the inside type. Besides giving stem thread protection against atmospheric corrosion, they also offer excellent service on vacuum lines as there is stem travel in only one direction, thus causing less wear in the stuffing box.

Ends

When so many types of piping are in use, there must, of course, be valve ends to match. Hence, there are screwed, flanged, socket welding, butt welding, and solder joint ends. Screwed ends are satisfactory for general service requirements but should be limited to sizes of 2-in. and smaller because of the difficulty of making-up larger threaded joints to a normal thread engagement.

Because of the inherent weakness of flanges, valves with flanged ends having ordinary facings are rated, according to A.S.A. Standards, for lower working pressures than screwed or welding ends; the exception being flanges with ring joint facings, in which case the ratings are the same. Socket welds and butt welds are preferred for higher pressure jobs; solder joints find their best application in liquid services for either domestic or industrial applications of less than 200-lb. pressure.

Selection

What valve to use? This is a question that comes up constantly wherever valves are used. The answer is simple. It lies in the application of plain, everyday common sense. There is a valve to fit every need. To make the proper choice, it is first necessary to determine some of the conditions that govern its operations. It is unreasonable to expect a tailor to make a suit with no other stipulation than that it must be dark blue. Nor would an order for merely a couple of dollars worth of "just groceries" bring results other than disappointing. In either of the above examples sufficient specifications must be given to obtain an intelligent result. So it is with the selection of valves. Basically, there are four major questions (listed below) that must be answered to insure proper valve selection. The answers are predicated upon a properly installed piping system; there must be no pipe-line sags or humps.

(1) The purpose of the valve must be indicated. If it is to be used for open or shut service, then a stop valve is wanted—so, use a gate. If it is desired to regulate flow at any point between closed and wide open, as in throttling, then a control valve is needed—so, use a globe, preferably one of the plug disk type.

(2) The nature of the fluid to be handled must be known. By definition, in this connection, a fluid is anything

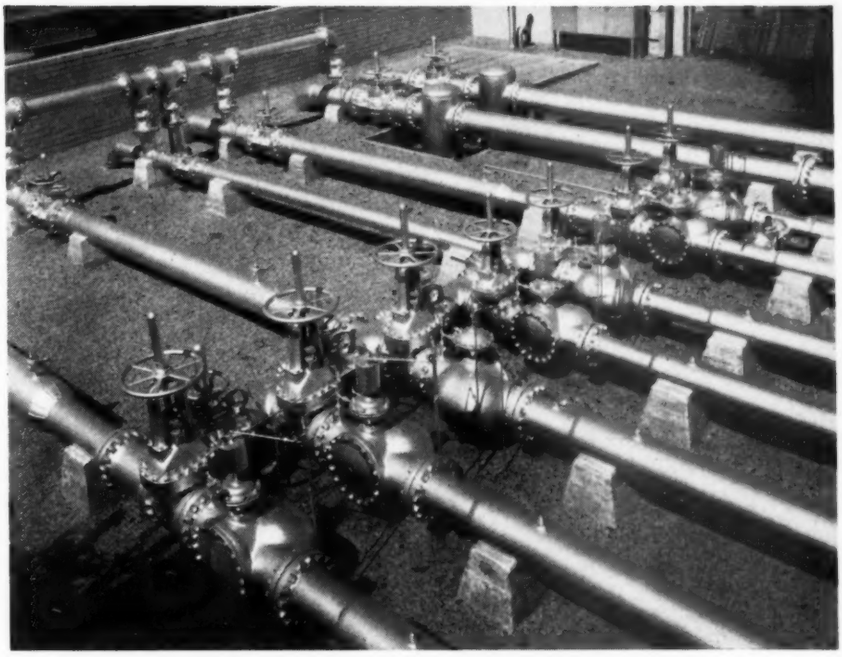
that will flow through pipes. It may be steam, water, oil, air, or gas. In order to assure lasting service, it is important to know the fluid and its characteristics. Is the fluid corrosive, and, if so, is it acid or alkaline? Does it carry suspended matter that would abrade the metal or settle out when flow stops? The answers dictate the types of disk, seat, stem and body, and the materials from which they should be made.

(3) The proposed operating pressure must be thoroughly considered. There is no particular problem in prescribing for a constant pressure. But, should there be a probability of fluctuation, which may commonly assume shock proportions, then ample provision must be made to handle maximum normal pressure with auxiliary means properly added to combat extreme instances wherein pressures seriously exceed good piping recommendations. Such precautions usually take the form of shock absorbers, usually spring loaded, or suitable air compression chambers.

(4) It is common knowledge that the strength of metals used in piping materials decreases as temperatures increase. For instance, good practice limits brass and cast iron to a safe limit of approximately 450°F. Steels have a maximum rating in keeping with that of the metals used as trim. Bronze trim combinations are suitable for a recommended maximum temperature of 750°F., Stellite trim is suitable for temperatures as high as 1000°F. for steam, and as high as 1100°F. for oil. Border line cases will reflect greater satisfaction if they comply with higher bracket specifications.

Size

One of the commonest practices in the application of valves is to choose a valve according to the size of pipe to which it is to be connected disregarding any comparison of suitability of size with required capacity under actual working conditions. It is not unusual to find a large valve operating with the disk just barely cracked off the seat and yet passing full required flow. Consequently, under such circumstances, service life is radically curtailed. How much better it would be to determine first the valve size that will pass full flow demand when wide open and then reduce the pipe size at point of installation to match that of the valve. In this way, the disk will be out of flow as completely as possible and the valve will give maximum service expectancy. Should full flow and minimum flow be too far apart, then one extreme may be handled through a bypass. Which extreme is selected is determined by the proportion of operation.



Valves and piping in a gas line manifold

Application

One of the most common questions in connection with the application of valves is, "shall the pressure be over or under the disk?" This is a point that not only confuses many valve users but seems never to be permanently clarified. If one will apply a little common sense, however, the answer will be readily found in the counter question, "what will happen to the equipment connected to the discharge of this valve if and when the valve becomes inoperative?" It is not impossible for the disk to come loose from the stem. Should this happen, is it better for flow to stop as, for instance, to a steam engine or to a steam-driven pump, or to continue as in the feedwater line to a boiler? If an engine control valve failed, this engine could run wild with probable serious results; hence, the pressure should be on top of the disk so that it will shut the valve and keep it shut. On the other hand, pressure should be under the disk for boiler feed service so that flow will continue and preclude the probability of an explosion from a dry boiler. In such operations as boiler blowdown, soot blower, and drip and drain lines, pressure on top of the disk is proper as any of these services may be delayed without hazard. Unless, therefore, the service clearly indicates that pressure should be under the disk, it is suggested that it be on top. This recommendation is made because, when pressure is on top, it aids in keeping the disk in a closed position thus compensating for any contraction of the stem, such as from cooling of a hot fluid, which might cause a slight lift of the disk off its seat and result in a leaky valve.

Installation

In the matter of installing equipment that requires piping connections, it is important to place shut-off valves and unions immediately adjacent to the equipment on all lines leading in or out of it. The unions, being between the equipment and the valves, will permit the easy removal of the equipment while the valves shut off flow without discontinuing service in the line.

It is worthy of mention that valves of large size, 12 in. and larger, have disks with generous areas exposed to line pressure. Obviously, this pressure when exerted against a disk in an unbalanced service, such as discharging from high to low pressure or to atmosphere, makes valve operation increasingly difficult as the exposed disk area increases. This condition is less pronounced in gate valves than in globes as disk movement in the former is across the line of flow, whereas, in the latter it is directly against flow. To minimize this condition, it is recommended that all gate valves 12 in. and larger and all globe valves 6 in. and larger be equipped with bypasses. Bypasses permit the pressure to be equalized on both sides of the disk, and valves that otherwise could be operated only with appreciable difficulty may be opened and closed with minimum effort.

One of the more frequent abuses of an otherwise excellent pipe line or pip-

ing assembly is the lack of adequate supports. Best results will be obtained from both valves and fittings, as well as the pipe itself, if the line is sufficiently supported to eliminate all transverse or sag stresses. It is not difficult to predict the reason a gate valve leaks if a sag in the line has distorted the valve body sufficiently to change the angle of the seats.

Caution is urged in screwing a valve on the end of a pipe, or other threaded connection, as it is not unusual to see a pipe wrench applied to the "far" end of a valve and, if sufficient torque is applied, the valve twisted out of line.

Thread Compounds

The subject of thread compound or "pipe dope," as it is sometimes called, is also worthy of review. To many users, these products are made for the specific purpose of making a leak-tight threaded joint by filling in the space between the threads. Actually, good threads need no filler. Properly designed and cut male and female threads are exact counterparts of each other and, when made-up into a joint with normal engagement, the fit is a perfect metal to metal contact and is tight. Because of friction of the dry metal, however, it is difficult to arrive at a normal engagement without lubrication of the thread faces, and it is for this very purpose that these compounds are used. They may be of a consistency varying from a light lubricating oil to one nearly as stiff as putty. Unfortunately, many threads, especially those cut by hand tools, are frequently so badly scored or imperfectly formed that a heavy bodied, semi-drying compound is necessary to fill the voids in order to obtain a drip-tight joint.

Caution is urged in the use of any thread lubricant. Always apply it to the male threads and never to the female. Otherwise the make-up action will surely shove the excess compound on ahead of the leading thread. If the compound is on the female thread, it will end up inside the pipe and may be washed off by the fluid passing through. If it is, it will most surely find its way to the seating surfaces of some valve or into the vital parts of some complicated mechanism. If, on the other hand, the compound is applied to the male thread, any excess is pushed to the outside of the pipe where it may be readily removed.

Although the points mentioned above are not new, especially to experienced operators, they are of sufficient importance to warrant repetition. They do not, of course, present a complete picture, because of space limitations. Undoubtedly, there are many users of valves who could add other helpful suggestions based on actual experience.

It is highly important in these days of national emergency for operators of all piping systems to obtain the maximum service of which their equipment is capable. No matter how good it is, there is always room for improvement, and it is with that thought in mind that these facts are presented.

——☆☆☆——

P 425.212.

Method of Spotting Drawworks When Rigging-up

WHEN rigging-up on a new location it is often difficult to spot the drawworks in the proper position on the substructure so that it will be perfectly aligned.

Sections of I-beams of any reasonable size available are "V'd" on one end as shown and welded to the substructure. Companion "Vs" are welded to the frame of the drawworks so that perfect alignment is obtained when the two sets of vees are engaged.

Both "spotters" are situated at the rear of the drawworks. Fig. 1 shows the one on the left. Fig. 2 shows the one on the right.

It is obvious that this arrangement may be adapted to any drawworks in a reasonably short time and the time saved in rigging-up will pay for the work several times over.

The accompanying photographs show a simple method of assuring perfect alignment almost automatically.

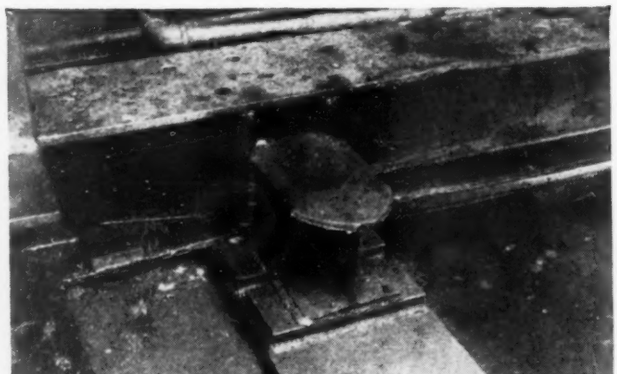


Fig. 1

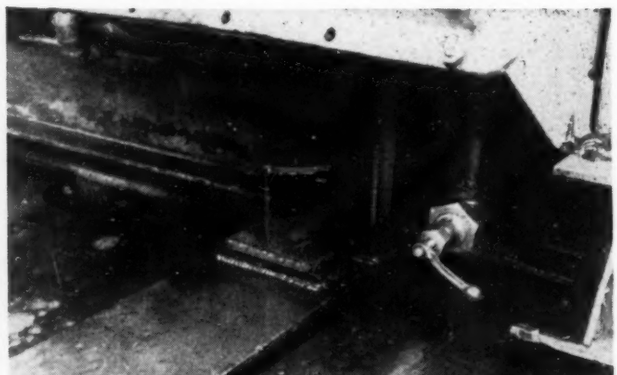
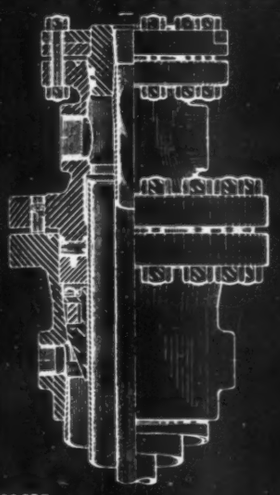


Fig.2

NATIONAL CASING HEADS

ADD TO THE *Speed* AND *Efficiency* OF WELL COMPLETIONS . . . . .

TYPE AL NATIONAL CASING HEAD WITH TYPE F TUBING HANGER



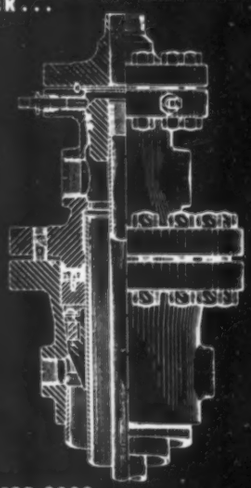
MADE FOR
2000 AND 4000 P.S.I. TEST PRESSURES

THE NATIONAL Types AL and AF Casing Heads increase the internal strength of the oil string by making it possible to suspend casing under proper tension.

In addition, completions are speeded up by using a National Type A Casing Cutter to cut off the Casing.

Interchangeable tubing hangers are available for various production practices. Flanges are made to API specifications. Flanged auxiliary control equipment for running tubing under pressure can be attached to tubing hanger spool.

TYPE AF NATIONAL CASING HEAD WITH TYPE FF SET SCREW ANCHOR TUBING HANGER . . .



MADE FOR 2000
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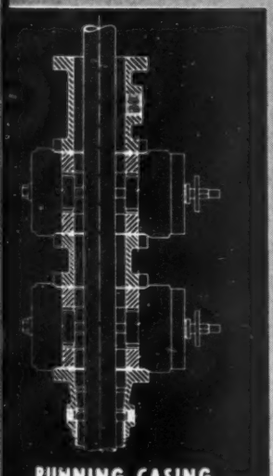
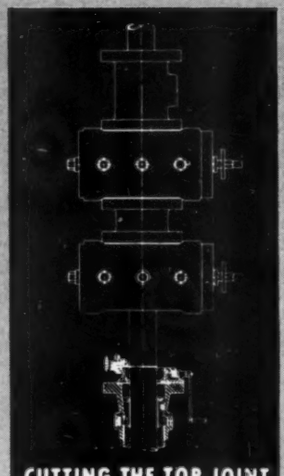
Completion Practice with NATIONAL Types AL and AF Casing Heads



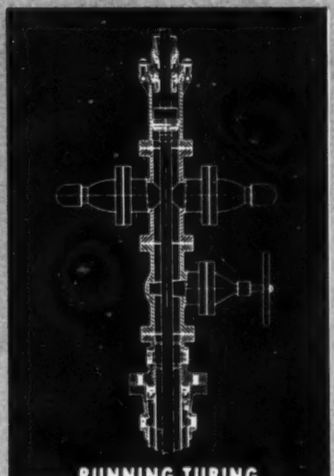
RUNNING CASING

The blowout Preventers are attached to the casing flange when the outer string is landed. The equipment remains in place until after the oil string has been run.



CUTTING THE TOP JOINT

Blowout Preventers are raised a minimum of 12 inches. Slips are installed in casing flange. Casing Cutter is placed around pipe and bolted to flange, as shown.



RUNNING TUBING

The Tubing Hanger Spool is bolted to the casing flange with Neoprene packing in place. Stripper control assembly is shown attached to upper flange for drilling in and running tubing under pressure.

By the use of the NATIONAL Type A Casing Cutter, casing can be set with the desired amount of tension and cut off without delay. These cutters are available for all Types AL and AF Heads.

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Deep in the rocky forests of New England the trench for the Portland-Montreal pipe line was literally blasted and hewn out of the rugged terrain

Portland-Montreal Pipe Line Completed in Record Time

PETROLEUM Exclusive

☆ **Natural obstacles overcome in laying defense line through rocky terrain of New England in 142 days**

by Frank H. Love
Managing Editor

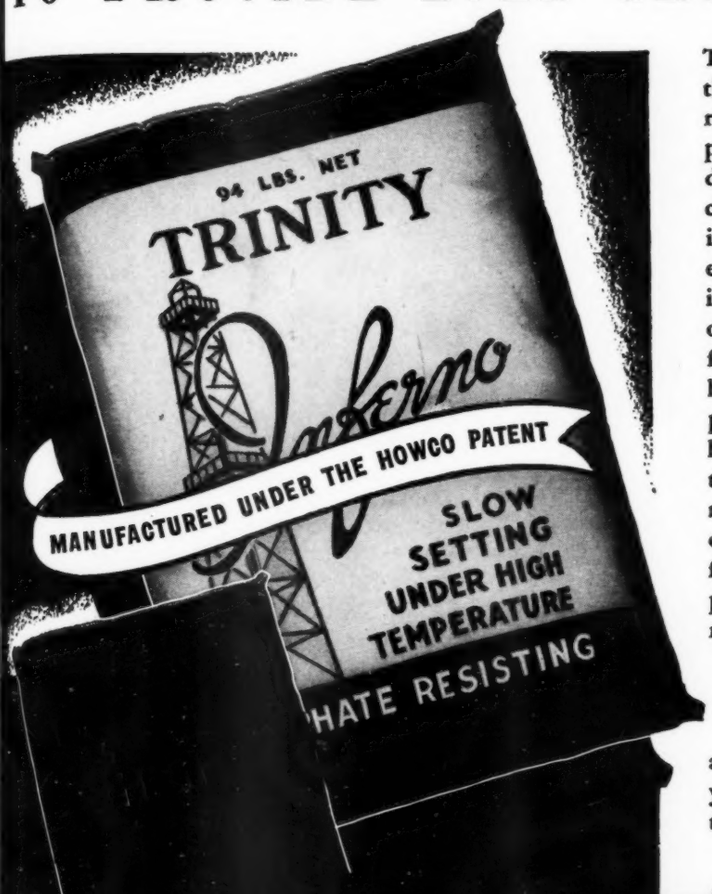
THE first national defense pipe line to be completed, the 236-mi. line from Portland, Maine, to Montreal, Canada, was formally opened in November. The initial shipment of crude oil through the system was brought to South Portland by the tanker Esso Dover from Covenas, Colombia.

The new line, constructed at a cost of $8,500,000, will save tankers 12 days on a round trip between South American or Gulf ports and Montreal where it is refined. By discharging their cargoes at Portland the tankers are saved the long trip through the Gulf of St. Lawrence and down the St. Lawrence River to Montreal. In addition to this saving in time it is now possible to deliver crude oil to Montreal refineries throughout the year. Heretofore tanker shipments to Montreal ceased as soon as ice clogged the St. Lawrence and closed the port for nearly five months of each year.

Because of the state of emergency the line was rushed to completion in the record time of 142 days. In that time 32,700 tons of 12¾-in. O. D. pipe having a wall thickness of ⅜ in. was laid and electrically welded.

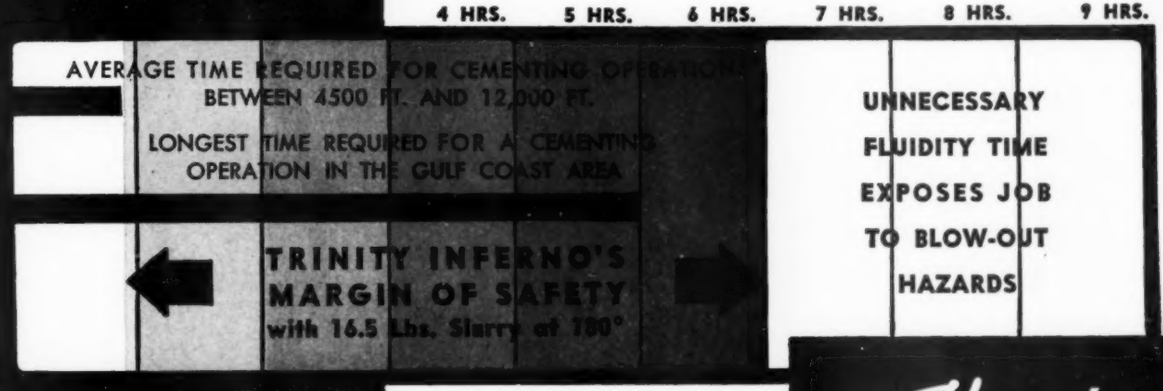
Specifications call for eight pumping stations; however, only four have been completed. With these four stations pumping, the line has a capacity of 25,000 bbl. per day. When the other stations are completed and placed in operation the capacity will be 60,000 bbl. per day. Delay in constructing the entire eight stations was occasioned by difficulty in obtaining materials and pumping equipment.

TRINITY *Inferno* INCREASES FLUIDITY TIME TO PROVIDE EVEN GREATER SAFETY FACTOR



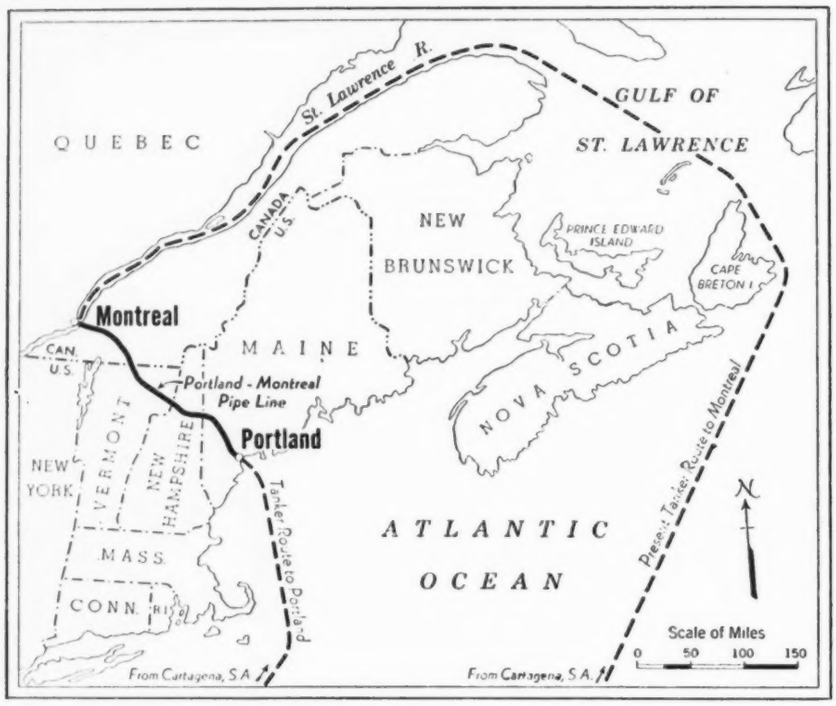
Trinity Portland Cement Company, one of the pioneers in slow-setting cement, has combined the research of its technical staff with the research and experience of Halliburton Oil Well Cementing Company to perfect an even better Inferno. The same high strength, dependable uniformity and easier pumpability which have always characterized Inferno have been retained, and fluidity has been increased to six hours with 16.5 slurry at 180°. Trinity Inferno exceeds the requirements for any deep well job. For cementing casing, squeeze cementing, and recementing it provides an ample margin of safety, but does not expose the job to hazards created by remaining fluid for an unnecessarily long time after the cementing operation has been completed. Trinity Inferno has the ideal fluid time, *plus* a protecting factor of safety for unforeseen delays, with minimum hardening time after the cement is placed. Cementing operations between 4500 ft. to 12,000 ft. show the average over-all time was 54 minutes. Records show that the longest time required for a cementing operation in the Gulf Coast area was 300 minutes. These figures are from the deep well cementing operations on the Gulf Coast for the past five years—and are the best evidence that Inferno's fluidity is right. Inferno's higher strength, easier pumpability, and greater uniformity have been generally recognized for the past five years.

These advantages, plus the new scientifically controlled fluidity time, give you maximum assurance of successful deep well cement jobs. If you're looking for a cement to handle the roughest, toughest jobs—put your money on Inferno.


4 HRS.
5 HRS.
6 HRS.
7 HRS.
8 HRS.
9 HRS.
AVERAGE TIME REQUIRED FOR CEMENTING OPERATIONS BETWEEN 4500 FT. AND 12,000 FT.
LONGEST TIME REQUIRED FOR A CEMENTING OPERATION IN THE GULF COAST AREA
TRINITY INFERNO'S MARGIN OF SAFETY with 16.5 Lbs. Slurry at 180°
UNNECESSARY FLUIDITY TIME EXPOSES JOB TO BLOW-OUT HAZARDS

ORDER FROM YOUR LUMBER AND BUILDING MATERIAL DEALER

There's a TRINITY CEMENT *for* EVERY OIL FIELD NEED



Map showing route of Portland-Montreal pipe line and route formerly taken by tankers to reach the latter point

The portion of the line south of the international boundary was constructed by the Portland Pipe Line Company and the Canadian portion was laid by Montreal Pipe Line, Ltd. Both are subsidiaries of the Standard Oil Company (New Jersey). The line is popularly known as the Esso line.

Sites for the eight pumping stations are at South Portland and near Raymond and North Waterford, Maine; at Gorham and Riverton, New Hampshire; West Burke, Vermont, and Highwater and St. Cesaire, Quebec. At each station a 30,000-bbl. storage tank is or will be erected. Utility electric power will be used at six stations —South Portland, Raymond, North Waterfield, Gorham, Riverton, and St. Cesaire — whereas Diesel engines will provide the power at West Burke and Highwater. The pumps are horizontal, triplex, plunger pumps.

At Portland, where the line originates, six 140,000-bbl. tanks have been erected to store crude oil received from tankers. From these tanks the crude is pumped into the pipe line for transportation to Montreal.

For the unloading of tankers at Portland a 920-ft. finger pier was constructed of steel and concrete to accommodate at one time two tankers of the 20,000-ton class. The cargo of such a tanker is 140,000 to 150,000 bbl. of crude oil. The tankers discharge the cargo with their own pumps into two storage tanks erected on the pier site. Each of these terminal storage tanks has a capacity of 140,000 bbl. They are connected to the principal

Making an electric weld on the 236-mile defense pipe line that was rushed to completion in record time of 142 days

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Workmen making shot holes near Gorham, New Hampshire, preparatory to blasting a ditch for the pipe line

storage facilities at South Portland by 2½ miles of 24-in. pipe. Because the soil of the area is impregnated with salt water, this pipe was given a ½-in. coating. Four pumps move the oil from the pier site to the tank farm where there are four 140,000-bbl. tanks.

Construction Methods

Beginning at sea level in Portland, Maine, the line extends northwestward. Near Newport, Vermont, just before the international boundary is reached, the highest elevation is attained—1950 ft. Until after the line has penetrated several miles into Canada the terrain in large part is rough and rocky. From that point to Montreal, however, the right-of-way is fairly level. In total, the line crosses 45 highways and railroads and 18 streams, the St. Lawrence, Richelieu, and Connecticut rivers being the more important of the latter. Under the St. Lawrence River, parallel 10-in. lines of pipe having ½-in. wall thickness were laid. The lines were laid 5 to 10 ft. beneath the river's bed and 45 ft. below mean low water. The trench had to be made through rock and shale overlain by soft material. A hydraulic dredge removed the soft material, after which the rock was broken by blasting and a ladder dredge used to remove it to the necessary depth.

In the case of the Richelieu River in Canada, which is quite swift, a trench was also cut in the rocky river bottom. This trench was not so deep as that of the St. Lawrence River, but was deeper than those provided for other river and stream crossings. In most of these latter instances the pipe was weighted with river clamps and placed in shal-

A charge of dynamite is set off in the quiet forests of New England hurling rocks and debris high in the air

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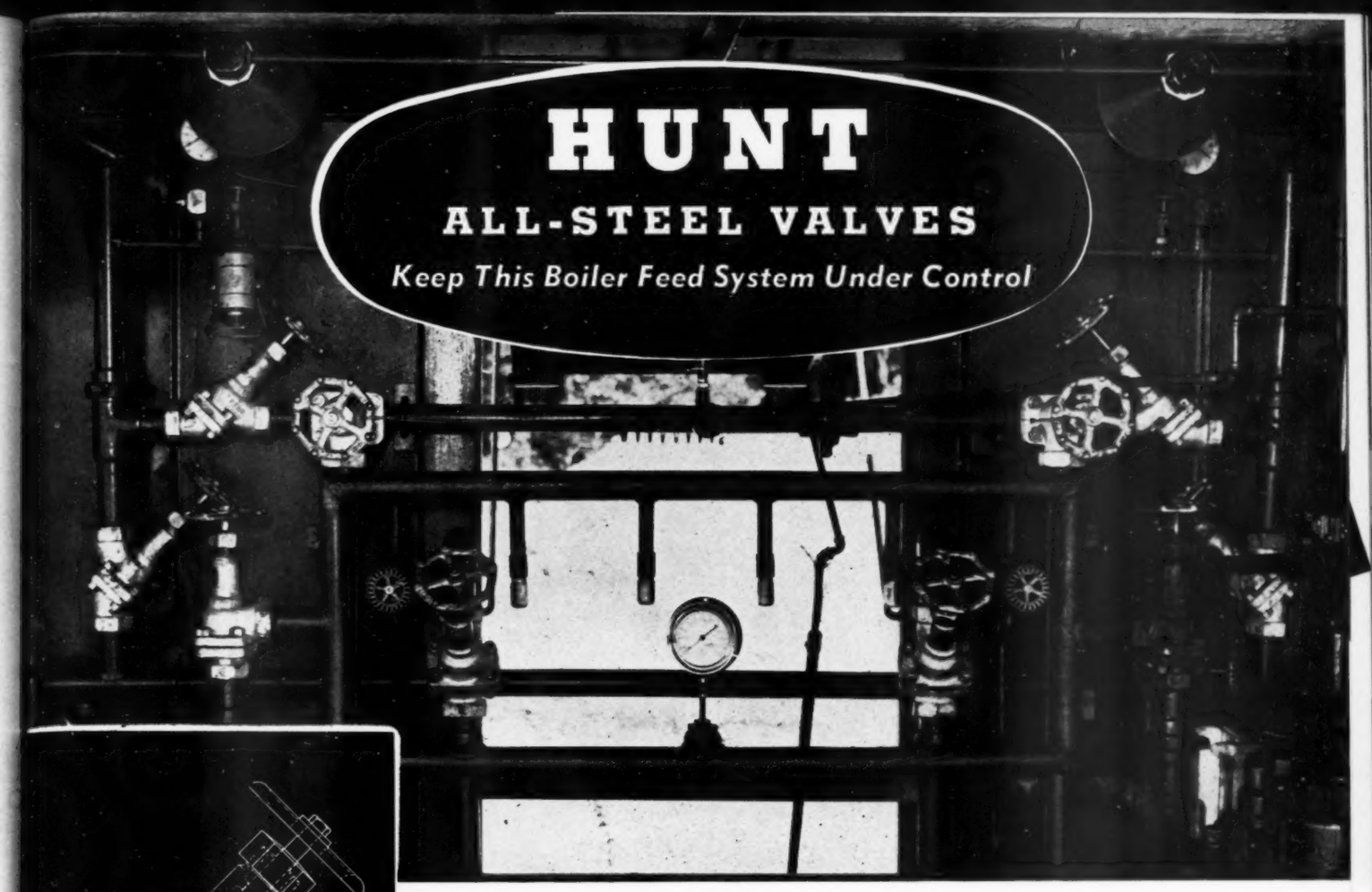

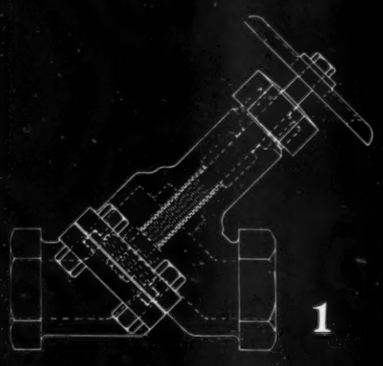

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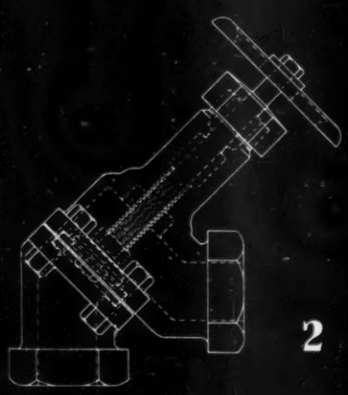

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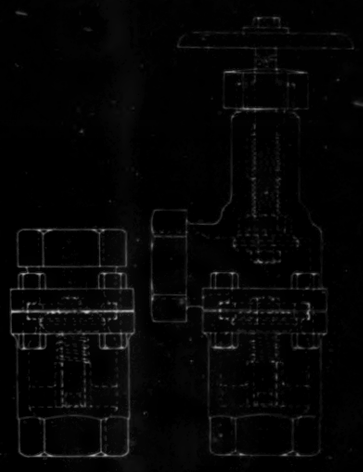

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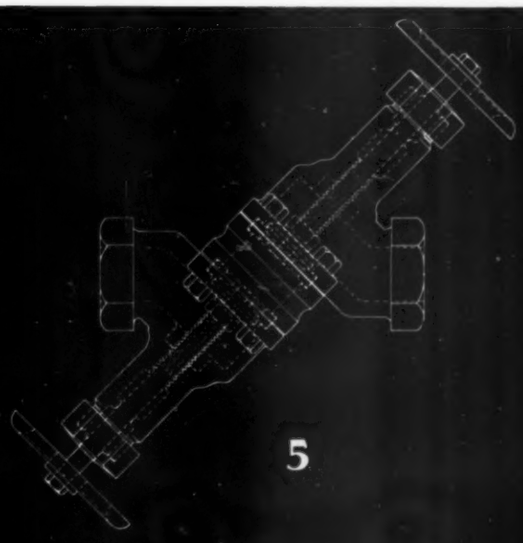

5

This boiler feed system on a Gulf Coast rig shows one of the numerous profitable applications of Hunt All-Steel Line Valves, the unique design of which has proved a time and trouble saver . . . a means of eliminating many costly fittings . . . a way to keep maintenance costs down.

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1. You can use it in this conventional 180° type . . . or 2, convert it to a 90° angle like this . . . or, with a slight change, 3, you can have this 90° line valve arrangement . . . and 4, you have this valuable combination by simply adding the check . . . or 5, you can even go into the double valve arrangement, 180° angle by doing this.

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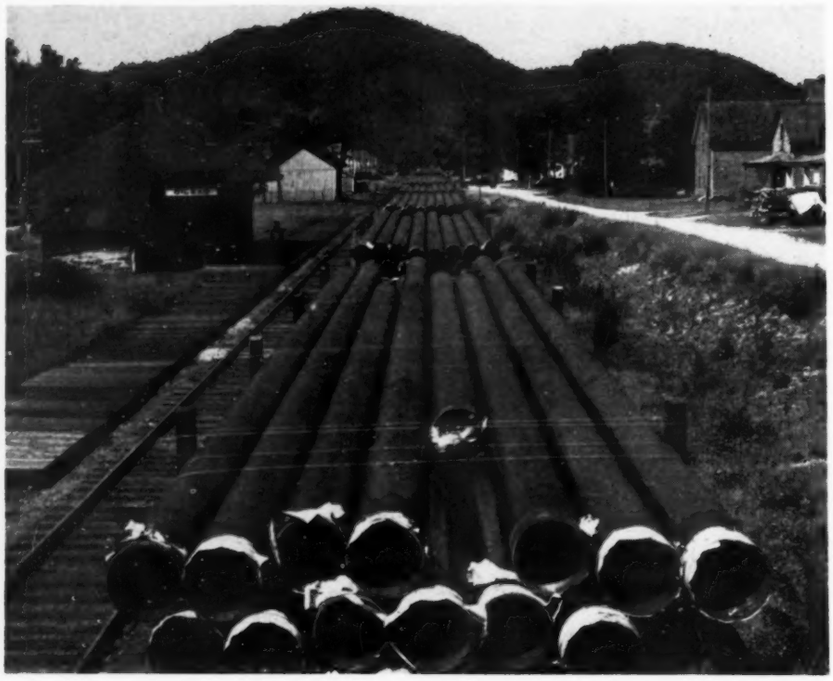


A trainload of pipe at Gilead, Maine, ready to be unloaded and transported by truck to the pipe-line right-of-way

low trenches. It was necessary to bury the pipe in the St. Lawrence River crossing at such great depth so that it would not be necessary to relocate it in event the 35-ft. river channel was ever deepened to permit passage of the largest ocean-going vessels.

Pipe used in all river crossings was thoroughly cleaned, primed, coated with hot enamel, and wrapped with asphalt-impregnated felt. The pipe was similarly protected in congested areas and for a short distance in Canada where the line was laid in peat bogs.

To determine the right-of-way for the line, United States and Canadian geological survey maps of the region were provided and with these as a basis an aerial survey was made from a plane flying at an altitude of 17,000 ft. From these photographs a mosaic map of the route was prepared. Field surveyors next laid out the route itself. After rights-of-way had been obtained, usually an easement through a strip of land 35 ft. wide, workmen began the job of clearing a path for the pipe line. With woodsmen to fell trees and bull-dozers to remove them as well as boulders and underbrush, the right-of-way was made approximately as serviceable as a secondary country road, being satisfactory for use by trucks and other rolling equipment as the line was built.

The trench was dug 3 ft. wide and to an average depth of 3 ft. Whenever possible ditching machines were employed. In certain types of terrain trench hoes were employed, and in rocky areas pneumatic drills and blasting were resorted to.

As the ditch was being dug the pipe, in 40-ft. random joints and weighing 49.56 lb. per ft., was strung along the right-of-way. In many instances the pipe had to be trucked through dense woods, up rugged mountains, and over almost impassable roads. On numerous occasions it was necessary for tractors to aid the trucks.

Pipe joints were electrically welded by the "stove-pipe" method, being held in position by "boom-cats" while the welders made the tack welds. Resting on skids above the ditch, the finish beads were run, the joints being welded in four passes. The welds will withstand a minimum pull test of 76,000 lb.

After the pipe was welded the line was lowered-in, again by means of "boom-cats," and backfilled.

Due to the uneven nature of the terrain, innumerable side bends, sags, and overbends were required. All of these were made cold, the bending being accomplished by two "boom-cats." The customary procedure is for one "boom-cat" either to ride the pipe or hold it with a winch at the point where the bend is to be made while the other with the aid of its boom and winch pulls the pipe until it acquires the proper angle.

Testing

The line was tested in sections and also as a completed unit. The general practice was to apply 120-lb. air pressure to the section completed each day. A scraper equipped with a rubber disk was inserted in the pipe at the beginning of each test, which was pushed through the line by the force of the air, removing accumulated debris. When the air pressure had been built-up to 120 lb., a soapsuds solution was applied to the joints to detect any leakage.

After the line was completed it was filled with water and the pressure built-up to 800 lb. As the normal operating pressure of the line is 720 lb. per sq. in., this hydrostatic test is considered sufficient to assure the proper safety factor.

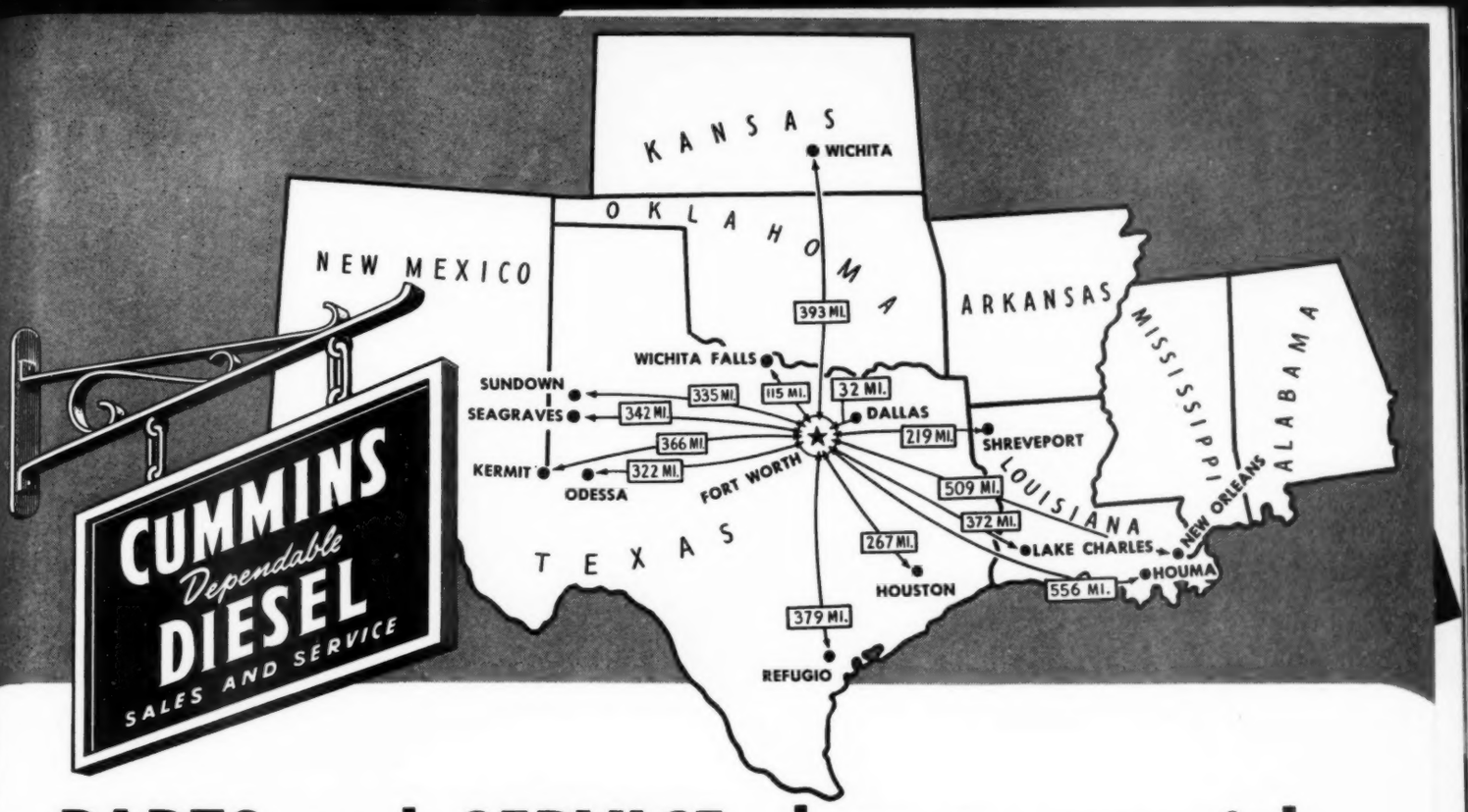
Effect of Frost

When the line was designed some apprehension was expressed as to the effect frost would have on the line. In the area traversed 10-ft. snowdrifts are not infrequent and frost penetrates the earth to a depth of 4 to 5 ft. Even though the line is laid at depths of only 2½ ft. in rock and 3 ft. in soil, technologists of the pipe-line company state there is no danger of frost heave damaging the line. The welded joints are stronger than the pipe itself, it is pointed out, and the strength of the pipe is indicated by its weight of 49.56 lb. per ft. and ⅜-in. wall thickness. It is also explained that the crude oil pumped through the line is loaded in seaports where temperatures average 80 to 90° F. and the warm water of the Gulf stream enroute to Portland will prevent any marked change in temperature of the crude oil. It is asserted that even when outside temperatures drop as low as 35° F. below zero the temperature of the crude oil will not go below 30° F. above zero. Thus no provision has been made to heat the crude oil to facilitate its flow through the pipe line.

Personnel and Contractors

The personnel of the Portland Pipe Line Company consists of H. M. Stevenson, chief engineer; G. A. Lee, general superintendent, and A. H. Chapman, chief engineer, South Portland Terminal.

The Oklahoma Contracting Company of Dallas, Texas, laid the section of line between Portland, Maine, and Gorham, New Hampshire, including the 24-in. section through South Portland. Williams Brothers Corporation of Tulsa, Oklahoma, contracted the line from Gorham to Montreal and also constructed the eight pumping stations. ——☆☆☆——



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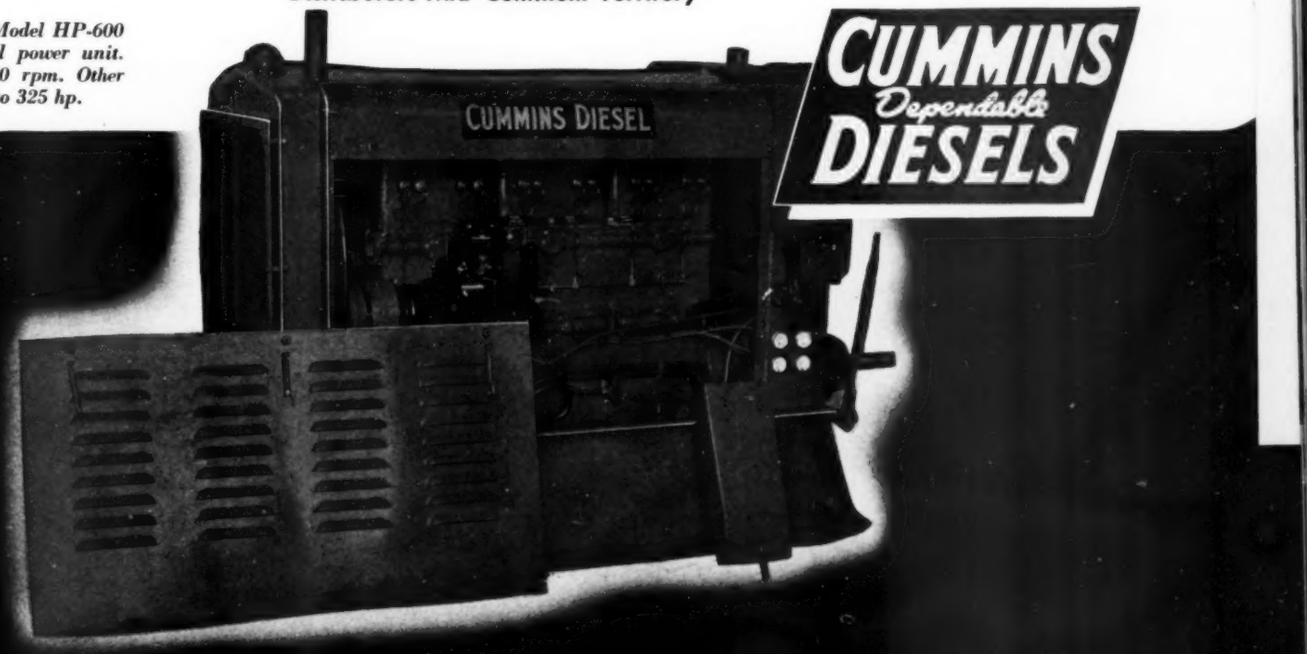

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☆ **Drilling rig can be torn down, skidded, and set-up in less than 12 hours under normal field conditions**

INASMUCH as drilling contractors are constantly in search of improved methods whereby the time and expense of moving from one location to another may be reduced, it is always of interest to note worthwhile developments along these lines.

The accompanying photographs are good examples of what can be accomplished in the way of assembling pumps and other units of drilling equipment on unitized bases that may be quickly transported.

Use of these unitized bases permits the drilling rig to be torn down, skidded, and set-up in less than 12 hours under normal field conditions.

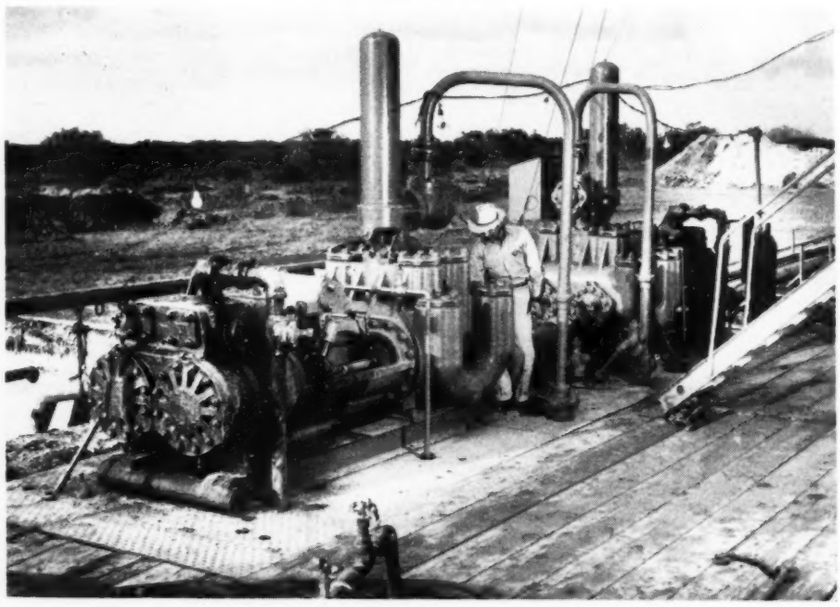
The skids for the units are made of discarded drill pipe using 6-in. for the bottom runners and 4-in. for the top. The width of the units conforms with legal requirements for highway transportation. The bottom of the structure is floored with steel plate to permit dragging and to protect the connections from injury.

Inasmuch as the greater part of the material used in these structures is secondhand or junk pipe and plate, the cost of the assemblies are less than one might think, judging from the neat workmanlike appearance of the completed bases after they have been painted. The work of fabrication was done solely by the company welder when he was not working on more urgent jobs.

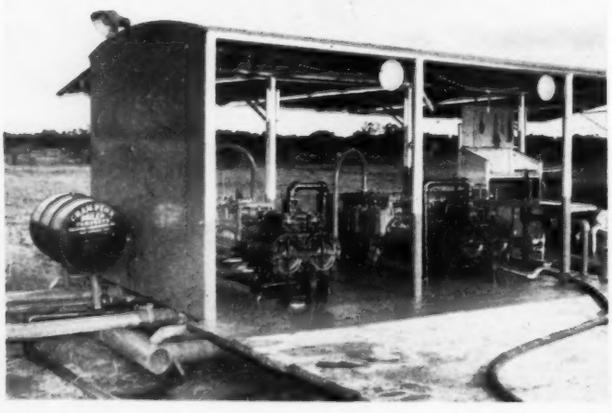
In Figs. 2 and 3, a good idea can be obtained of the method whereby the skids are fabricated. It will be noted that the suction and discharge lines of the pumps are readily accessible and may be quickly connected by unions. The size of the housing over the boiler feedwater pumps may be raised or lowered. This arrangement of equipment was worked out by employees of Allied Drilling Company, San Antonio, Texas. Thus far, two rigs have been unitized and it is planned to unitize two more in the near future.

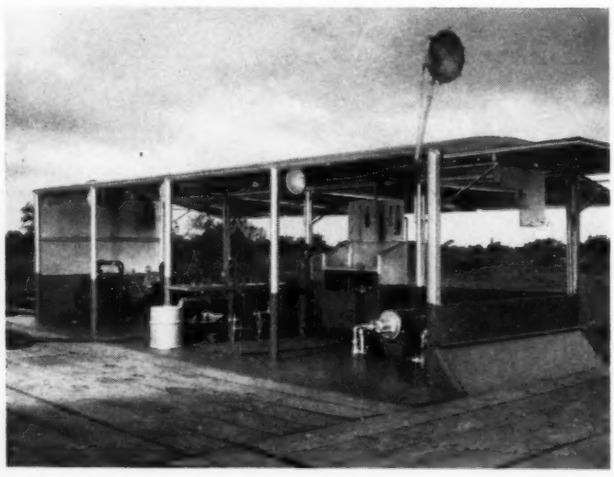
☆ ☆ ☆

Fig. 1. The two mud pumps are mounted on a single base that is quickly loaded and unloaded by truck

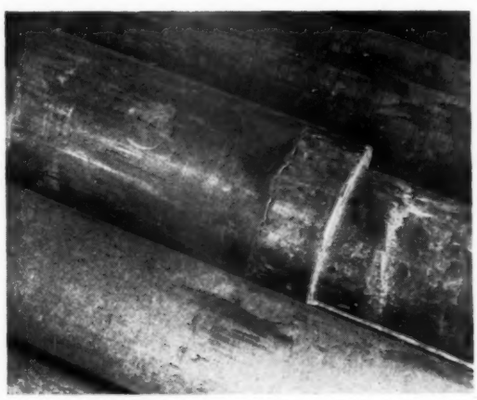


Figs. 2 and 3. Showing construction details whereby boiler feedwater pumps are unitized





And make them last twice as long as new!



The tool joint shown at left is one of 25 hard-faced with Electric Tube Borium, applied to a ⅛" recess 1½" wide. Each hard-faced joint was spaced by ten unfaced joints and moved up or down the string during the run. *After 18,000 feet of drilling, unprotected joints were* 5/8" *to* 7/8" *undersize on OD . . . hardfaced joints showed NO WEAR!* Of the unprotected joints, only 127 out of the original 275 were fit for further service, and almost all were worn egg-shaped while the hard-faced joints were still concentric. Present savings—$20 per joint. Savings by the time run is completed may be as high as $60 per joint!

Tops in normal tool joint life amounts to about 18,000 feet of drilling in the Bryson, Texas, area—so tough is this district on unprotected joints. But illustrated at left is part of a string of integral tool joints rebuilt several months ago with high carbon and then hard-faced over the wearing surfaces with Coated Stoody Self-Hardening. *This string has now drilled between 24,000 and 25,000 feet of hole and is still good for several additional wells.* Tool joint life has been increased 150%—and by the time the hard metal deposits completely wear away will approximate 200%!

Shortage of steel need not put a crimp in your drilling plans as far as tool joints are concerned. Stoody Hard-Facing Alloys are doubling normal tool joint life—or *more*—and making substantial savings in equipment costs for many operators in many different fields. *Old* tool joints are being reclaimed for thousands of feet more service. *New* joints are being protected against rapid wear. *All* protected joints are standing up *longer* under the terrific grind of modern drilling.

The Stoody Alloys used in renewing tool joints are either Electric Tube Borium or Coated Stoody Self-Hardening, and the application is simple. Contact the Stoody representative nearest you for detailed information—or write Stoody Company for your free copy of the Engineering Bulletin which recommends methods and materials to meet every requirement.

STOODY COMPANY, 1134 W. Slauson Ave.
Whittier, California

STOODY COMPANY

Obtaining Asphalt Flux by Reducing Michigan Crude Oil

PETROLEUM ENGINEER Exclusive Feature

☆ **Twenty-five hundred bbl. per day skimming plant cuts variety of overhead and side streams—Obtains residuum of 15 deg. A.P.I.**

by J. C. Albright

ASPHALTIC fluxes and related commodities are manufactured by Producers Refining, Inc., at West Branch, Michigan, with vacuum applied on the bottoms from the topping plant. Crude oil produced at West Branch is a mixed base, predominantly asphaltic, and is processed through a 2500-bbl. per day skimming plant that cuts a variety of overhead and side streams, resulting in a residuum having an A.P.I. gravity of 15 deg., which is charged in a split stream to the vacuum reduction side of the refinery.

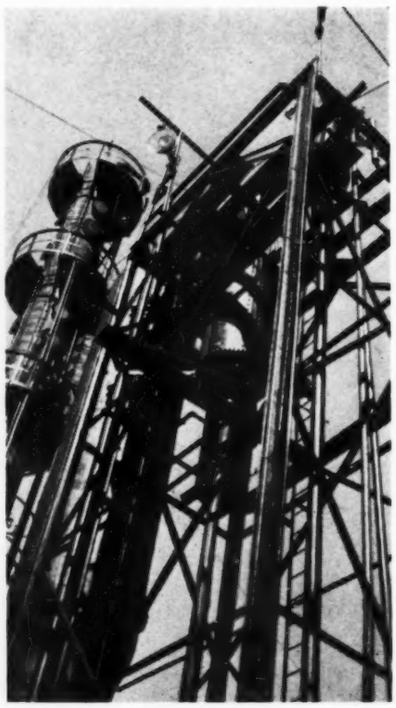
Not all the skimming plant topped crude oil is required for the manufacture of asphaltic fluxes, and the bottoms are run from the fractionating column through a liquid-level controller that allows the desired quantity to pass to the vacuum charge pumps and the remainder to flow through exchangers and coolers to industrial fuel oil storage. The 15-deg. A.P.I. bottoms represent approximately 40 percent of the fresh crude oil charge to the skimming plant, and approximately 60 percent of the bottoms can be made into 600 flux.

Inasmuch as a number of related asphaltic fluxes are made in this plant, each requires a different set of operating conditions. The topped 15-deg. A.P.I. bottoms are pumped without benefit of heat exchangers from the topping plant fractionating column base directly to the vacuum unit heater. If the product desired is to be a 600 flux, the vacuum heater transfer temperature is maintained at 740° to 750° F., leading directly to the vacuum column, which is 5 ft. by 41 ft., equipped with two ejectors, the larger having a capacity of 1000 lb. per hr. with 90-lb. steam, and the smaller a capacity of 350 lb. per hr. with 90-lb. steam.

When the plant is balanced to manufacture the 600 flux, the vacuum column is operated at 25 in. Hg. vacuum. In the process, two overhead streams of light wax distillate having a flash of 380 are produced with a side stream of light wax distillate having a flash of 440. If the plant is balanced to make an SC5 road oil, the heater transfer temperature is maintained at 680° F., and the vacuum column operated at 15 in. Hg. vacuum, requiring only the larger vacuum ejector to obtain these processing conditions. SC6 road oil requires a transfer temperature of 700° F. and a vacuum column condition of 17 in. Hg. vacuum. The overhead cut at this time has a flash of 370 and an A.P.I. gravity of about 25 deg.

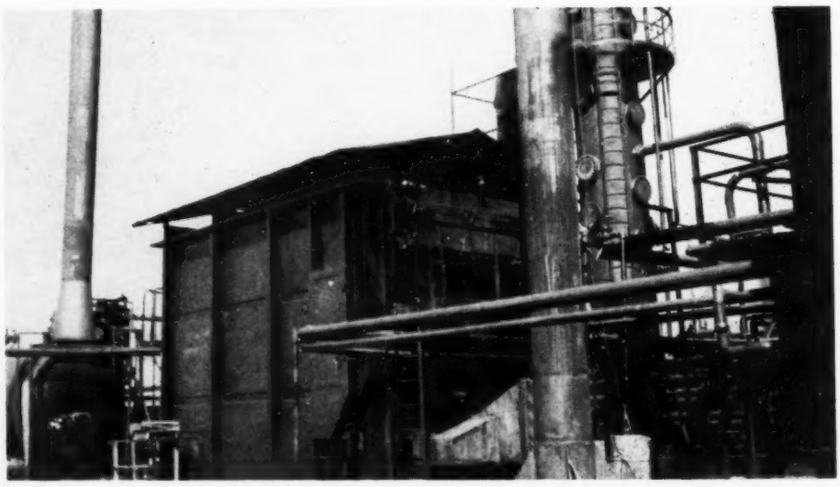
The heater used in the vacuum side of the plant is one formerly employed on the skimming section, but was transferred to asphalt flux and road oil manufacture when a new heater was erected for the skimming plant.

——☆☆☆——



LEFT—Top of skimming column and vacuum equipment

BELOW—Heater used in the process of making asphalt fluxes



Petroleum Electric Power Association

ANNUAL CONFERENCE
DALLAS, TEXAS

Don Knowlton, Phillips Petroleum Company, Bartlesville, Oklahoma, who delivered a paper on "The Future of Oil Production Viewed From the Standpoint of Present Day Production Methods."

J. E. Elliott, Southwestern Gas and Electric Company, Shreveport, Louisiana.

A. N. Horne, general manager, Empire Pipe Line Company, Bartlesville, Oklahoma, who presented a paper on "Pipe Lines and the National Defense."

A. R. Watson, Texas-New Mexico Utilities Company, Plainview, Texas; D. C. McKee, Empire District Electric Company, Joplin, Missouri; F. M. Austin, Houston Lighting and Power Company, Houston, Texas.

F. M. Austin, Houston Lighting and Power Company, Houston, Texas; P. M. Cordell, Texas Electric Service Company, Fort Worth, Texas, who was elected secretary-treasurer of the association; W. H. Stueve, Oklahoma Gas and Electric Company, Oklahoma City, Oklahoma; Lewis Blalock, Texas Power and Light Company, Dallas, Texas.

Dave Levy, Magnolia Pipe Line Company, Dallas, Texas; Jack Swindell, Westinghouse Electric and Manufacturing Company, Dallas, Texas.

Front row: K. K. Kreamer, Houston Lighting and Power Company, Houston, Texas, secretary-treasurer during 1941, who was elected vice-president of the association; E. L. Robinson, Gulf States Utilities Company, Beaumont, Texas, president of the association during 1941; P. M. Cordell; A. N. Horne. Standing: Duane Landon, St. Joseph Railway, Light, Heat, and Power Company, St. Joseph, Missouri; H. C. LeVois, Gulf States Utilities Company, Beaumont, Texas, who was elected a director of the association; E. A. Armstrong, Public Service Company of Northern Illinois, Chicago, Illinois, elected a director; Glenn Coleman, Public Service Company of Oklahoma, Tulsa, Oklahoma, also elected a director; H. W. Ellis, Public Service Company of Northern Illinois, Streator, Illinois; A. R. Watson; H. E. Roberts, Empire District Electric Company, Joplin, Missouri, new president of the association.

H. C. Thuerk, president of the Bradford Electric Company, Bradford, Pennsylvania; A. B. Morgan, Edison Electrical Institute, New York, New York.

Back to shirtsleeves! A.P.I. Production Division's hard-working boss, J. E. Stilwell, telephones instructions from his headquarters in a Palace Hotel suite, while Jeanette Laurin stands by to take dictation. This division was one of the busiest at the convention in San Francisco.

INTERNATIONAL NEWS PHO

Officials open a valve at the South Portland pumping station to send the first oil through the recently completed defense pipe line from Portland, Maine, to Montreal, Canada.

Personalities at Random

The Correlating Committee on Measuring, Sampling, and Testing Crude Oil shown in busy session in one of the conference rooms of the Palace Hotel, San Francisco, during the American Petroleum Institute Convention. One of the most important committees of the convention, its chairman was W. R. Trelford, seen at right of the table head; secretary was C. A. Young on Trelford's right.

One of the largest committees of the recent A.P.I. Convention, the Committee on Well-Spacing and Allocation of Production, pictured in session in the French Room of the Palace Hotel, San Francisco. D. R. Knowlton was chairman.

A.P.I. President William R. Boyd, Jr., who was re-elected to this post during the convention in San Francisco, Calif., and Harold L. Ickes, Secretary of the Interior and Petroleum Co-ordinator, photographed at the first General Session.

W. L. Childs, Reed Roller Bit Company, Houston, Texas, addressing the general session of the American Association of Oilwell Drilling Contractors Convention at Dallas, Texas.

N. A. Endicott, Continental Supply Company, Dallas, Texas, and Joseph Zeppa, Delta Drilling Company, Tyler, Texas, taken at recent meeting of drilling contractors in Dallas.

W. N. Agey (left), Agey Drilling Company, Monahans, Texas, and John J. Klise, Kenrow Company, Wooster, Ohio, make some notes at meeting in Dallas, Texas, of American Association of Oilwell Drilling Contractors.

Talking it over at the recent drilling contractors convention in Dallas are D. A. Powell (left), Drilling and Exploration Company, Inc., Hobbs, New Mexico, and Emery Carper, Carper Drilling Company, Artesia, New Mexico.

Howard P. Holmes (left), Two States Drilling Company, Dallas, Texas, was elected a director-at-large at the recent meeting of the American Association of Oilwell Drilling Contractors; H. A. Schaeffer, oil producer, Dallas; C. L. Rowan and F. W. Briggance of Rowan Drilling Company, Fort Worth, Texas; Wm. D. McBee, M. J. Delaney Company, Dallas.

W. W. Runkle (left), Hazard Wire Rope Division of American Chain and Cable Company, Inc., Fort Worth, Texas; Heber Beardmore, Jr., Beardmore Drilling Company, Wichita, Kansas; R. S. "Dick" Richards, Atlas Imperial Diesel Company, Fort Worth; H. K. Beardmore, Beardmore Drilling Company, Wichita; B. N. Burns, Hazard Wire Rope Division of American Chain and Cable Company, Inc., Fort Worth. Photographed at recent meeting of drilling contractors in Dallas.

A. A. Buchanan (left), Al Buchanan Drilling Company, San Antonio, Texas; Walter G. Tschudin, of Pioneer Drilling Company, Salem, Illinois, and regional director of North Central Paleozoic Basin, and Jas. H. Tucker, Mission Manufacturing Company, Houston, Texas. Photographed at drilling contractors convention in Dallas.

F. M. Mayer (left), Continental Supply Company, Dallas, Texas, and Walter G. Tschudin, Pioneer Drilling Company, Salem, Ill.

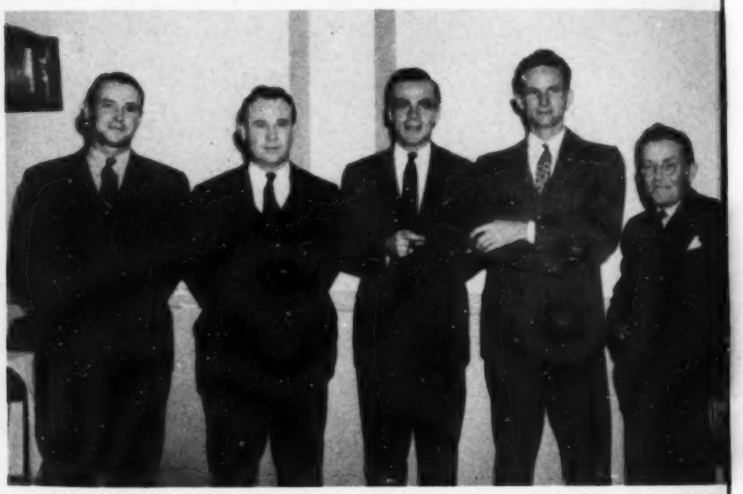
Snapped at meeting of American Association of Oilwell Drilling Contractors (left to right): W. J. Nutto, Reed Roller Bit Company, Houston, Texas; G. J. Alexander, J. I. Roberts Drilling Company, Shreveport, Louisiana; Mark Gardiner, Phillips Petroleum Company, Oklahoma City, Oklahoma; Ed Monroe, Reed Roller Bit Company, Wichita Falls, Texas.

East Texas Chapter A. I. M. E., Kilgore, Texas

Left to right: N. N. Jones, chairman, East Texas Chapter of A.I.M.E.; G. E. Archie, Shell Oil Company, Inc., Houston, Texas, who delivered a paper on "The Use of Electrical Resistivity Logs to Determine Some Reservoir Characteristics."

From left to right: Ben H. Ravonelli, Oil Well Supply Company, Dallas, Texas; Ralph Ludwick, Engineer, Stanolind Oil and Gas Company, Greggton, Texas; E. H. Jensen, International Derrick and Equipment Company, Kilgore, Texas; Roy Smith, Stanolind Oil and Gas Company, Greggton; (foreground) James Storrie, Atlantic Refining Company, Longview, Texas; (background) C. F. Maxwell, who is chairman of the Membership Committee, East Texas Chapter of A.I.M.E., and Roy Lamb, Merla Tool Company, Dallas, Texas.

W. S. (Buck) Morris,(left), chairman, East Texas Engineering Association, and chairman of Papers and Programs Committee, East Texas Chapter of A.I.M.E., Kilgore; R. D. Risser, division manager, Shell Oil Company, Inc., Kilgore; Pat E. Fletcher, engineer, The Atlantic Refining Company, Longview, and E. B. Miller, Jr., Tide Water Associated Oil Company, Inc., Kilgore, and chairman of East Texas Chapter of A.P.I.



From left to right: Pat E. Fletcher, Atlantic Refining Company, Longview; W. H. Wiginton, Atlantic Refining Company, Kilgore; H. D. Robinson, Atlantic Refining Company, Longview; W. H. Clemo, National Tank Company, Longview, and Frank Dana, Delta Drilling Company, Tyler, Texas.

John Shimer, Jr., Sun Oil Company, Chapel Hill, Texas

Woody Irwin, Salt Water Control, Inc., Tyler, and D. M. Kerr, Lufkin Foundry and Machine Company, Lufkin, Texas.

J. L. Puterbaugh, Sun Oil Company, Kilgore, Texas.

Faith

OUR FAITH lies in the indomitable nature of Man . . . typified by you and thousands of others in all walks of life who have solved, step by step, the most baffling problems in the world.

WHEN YOU REALIZE that in hardly more than a century Man has harnessed steam, combustible fuels and electricity to do his will . . . that he flies nearly eight miles in the air, travels fathoms under the sea, flings his voice around the world in an instant, predicts to the second, minute and day when an eclipse will occur 20,000 years hence, weighs the very earth on which he stands, turns night into day with a hair-fine filament and freezes by heating . . . then surely your problems of today are within the realm of mastery.

WITH US, AS WITH YOU, it is shortage of manpower and materials that makes the going tough . . . but we are finding answers to problems that at first appeared insurmountable.

SUBSTITUTES may replace some familiar materials out of necessity . . . design changes may result . . . but Progress has not stopped at Kerotest.

KEROTEST VALVES AND FITTINGS, being produced as rapidly as possible, are the result of progressive designing and the well-chosen use of available materials that still maintain the same accuracy, dependability and serviceability you have always known as the hallmark of Kerotest products.

OUR FAITH has proved well-placed in Man . . . who unfailingly accomplishes the seemingly impossible. Our faith is rewarded by the continued, even though somewhat limited, production of top quality Kerotest Valves and Fittings in the face of most adverse supply conditions.

SHARE WITH US a similar faith in dealing with your own problems and look to Kerotest, as always, for the dependability and acknowledged economy of genuine Kerotest Valves and Fittings.

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P 629.91

Line-up for tie-in weld is made under difficulties

by

W. B. Poor

Supervising Engineer,
United Gas Pipe Line Company

Marine Pipe-Line Construction Methods Employed in Lake Pontchartrain Crossing

☆ Longest submarine high-pressure gas pipe line yet laid in the United States, 25.59 miles in length, successfully completed by United Gas Pipe Line Company

DURING the months of September and October, 1941, there was constructed across Lake Pontchartrain, near New Orleans, Louisiana, the longest submarine high-pressure gas pipe line in this country. The occasion for this particular piece of difficult construction was United Gas Pipe Line Company's Lirette-Mobile project whereby additional gas was made available to that portion of the company's system east of the Mississippi River to supply the newly expanded demand for fuel to the industrial defense areas of southeast Louisiana, Mississippi, Alabama, and in the vicinity of Pensacola, Florida.

Before deciding upon constructing the line across Lake Pontchartrain serious consideration was given to a land route skirting the western and northern shores of the lake. The shorter submarine crossing was favored over the land route because of a saving of 12 miles in pipe-line mileage and due to the fact that the land route under consideration lay through impenetrable cypress swamps and marsh lands. The lake crossing presented only the problem of the proper use of adequate marine equipment and a gamble with weather conditions on a temperamental body of water.

W. B. POOR

received a B.S. degree in mining engineering from the Ohio State University, 1926—Upon graduation he spent two years in Alaska on plant design and construction for U. S. Smelting, Refining, and Mining Company—Then followed three years with Columbia Engineering and Management Corporation on design and construction in connection with operating gas properties in Ohio, Pennsylvania, and West Virginia—Since 1931 he has been with the Engineering Department of United Gas Pipe Line Company and affiliates in the capacities of distribution engineer, transmission engineer, and since 1936 as supervising engineer—His headquarters are in Shreveport, Louisiana.

Lake Pontchartrain is not a true lake, but is a land-locked salt water bay, approximately 40 miles long and 24 miles wide, having a maximum central depth of 16 ft. decreasing uniformly to about 6 ft. near the shore. On the east it communicates with Lake Borgne and Mississippi Sound by Rigolets Pass through which the tide enters. The lake bottom is composed of fine silt deposited by the Mississippi River, except for a comparatively narrow rim of sand along the north shore. Being so shallow the lake is subject to severe surface disturbances when winds of even mild force are prevailing.

Location

The point at which the pipe line enters Lake Pontchartrain on its south shore was determined by the shortest route, 8.17 miles, from the pipe-line crossing on the Mississippi River to the lake. The route is through an area of cypress swamps and open marsh lands except for a strip of comparatively high ground approximately 4000 ft. in width paralleling the river. The point of entrance to the lake is some 18 miles west of New Orleans, in St. Charles Parish, and is accessible only by boat. The pipe line leaves the lake on the north shore at a point just east of Mandeville in St. Tammany Parish. The terrain at this site, although low, is sandy and readily accessible by road.

Flupacos are now DOUBLY IMPORTANT...

LET'S SIMPLIFY OUR PUMP LINE!

Sometime ago, Fluid Packed launched a long-range pump development program. Its aim was to make pumps so downright simple, so long-wearing, yet so efficient that they could replace costly conventional types *—and thus save you more production dollars. The result is the present line of improved Flupaco "Hardened and Honed Groove Seals"!*

WE'RE SAVING STEEL AND USING FEWER REPLACEMENT PARTS!

And right now, it's *doubly* important that "Groove Seals" have such advanced performance features. For one thing, elimination of all unnecessary parts is saving tons of valuable steel for defense requirements. For another, there's *less* steel for you to buy . . . *less* to wear . . . *less* to ever need replacement . . . and so *less* production expense. These new "Groove Seals" are replacing—and out-performing—pumps that in many cases weigh *four times* as much! And this record has been possible by putting performance *in* and taking needless bulk *out!*

"GROOVE SEAL" Features

Flupaco "Groove Seals" incorporate the newest Flupaco design and construction features . . . yet they're available at an unusually economical price . . .

They have one-piece alloy steel barrels, precision honed to a mirror finish in multiple-spindle machines perfected by Flupaco and built by Flupaco for this purpose . . .

The barrels are heat-treated under a new process—also worked out by Flupaco engineers—which has resulted in 2 to 5 times more wearing life than heretofore available . . .

Machine-straightening—a recent addition to Flupaco's modern manufacturing process for "Groove Seals"—insures smooth, effortless plunger feed under all conditions . . .

Detailed gauging with precision measuring instruments gives unmatched quality control in every part, every assembled pump that leaves the Fluid Packed shop . . .

"Groove Seal" up-to-the-minute construction features give you smoothness . . . complete adaptability to all conditions . . . longer service at lower cost. There's a "Groove Seal" for any well capable of using an insert type pump!

YOU CAN GET FLUPACOS ALL SIZES, MANY METALS!

Find out today how these newest Flupaco Pumps will fit into your production program. "Groove Seals" can be supplied in the size, type and metal to meet a wide range of well conditions. Fluid Packed Catalog No. 9, just off the press, illustrates and describes the full line of Flupaco Pumps for all types of pumping jobs. Send for your free copy of this valuable Catalog *today*—or see your nearest Fluid Packed representative!

FLUID PACKED PUMP CO.

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MID-CONTINENT: HUNT BLDG., TULSA, OKLA.; 2 S.E. 29th ST., OKLAHOMA CITY, OKLA.
GULF COAST HEADQUARTERS: 2301 CONGRESS AVENUE, HOUSTON, TEXAS

WORLD'S LARGEST EXCLUSIVE OIL WELL PUMP MANUFACTURERS

The lake crossing thus determined is 25.59 miles in length.

Design

The design conditions on the lake crossing required that the pipe size be such that no excessive pressure drop would occur in the crossing when delivering the maximum designed load, approximately 80,000,000 cu. ft. per day, and that the physical characteristics of the line be such as adequately to withstand the construction hazards as well as operating conditions in this large, shallow, exposed body of water. The line as designed is capable of carrying internal pressures in excess of 600 lb. per sq. in. gauge.

The pipe chosen for the construction of this crossing was 14-in. O. D. seamless steel tubing having a ½-in. wall thickness and weighing 72.09 lb. per linear ft. The average length per joint was 43 ft. The quality of the steel was A.P.I. Grade "A" having a guaranteed minimum tensile strength of 48,000 lb. per sq. in. All pipe was mill inspected by an independent inspection firm. These inspections revealed that the tensile strength of the steel varied between the limits of 59,500 and 66,400 lb. per sq. in. All pipe was beveled at the mill for field welding of the joints.

The protection of the pipe line from corrosion in this brackish body of water, infested with barnacles and various types of marine borers, presented a serious problem. The experience of other companies under similar conditions was studied, together with the final report of the "A.P.I. Coating Tests."

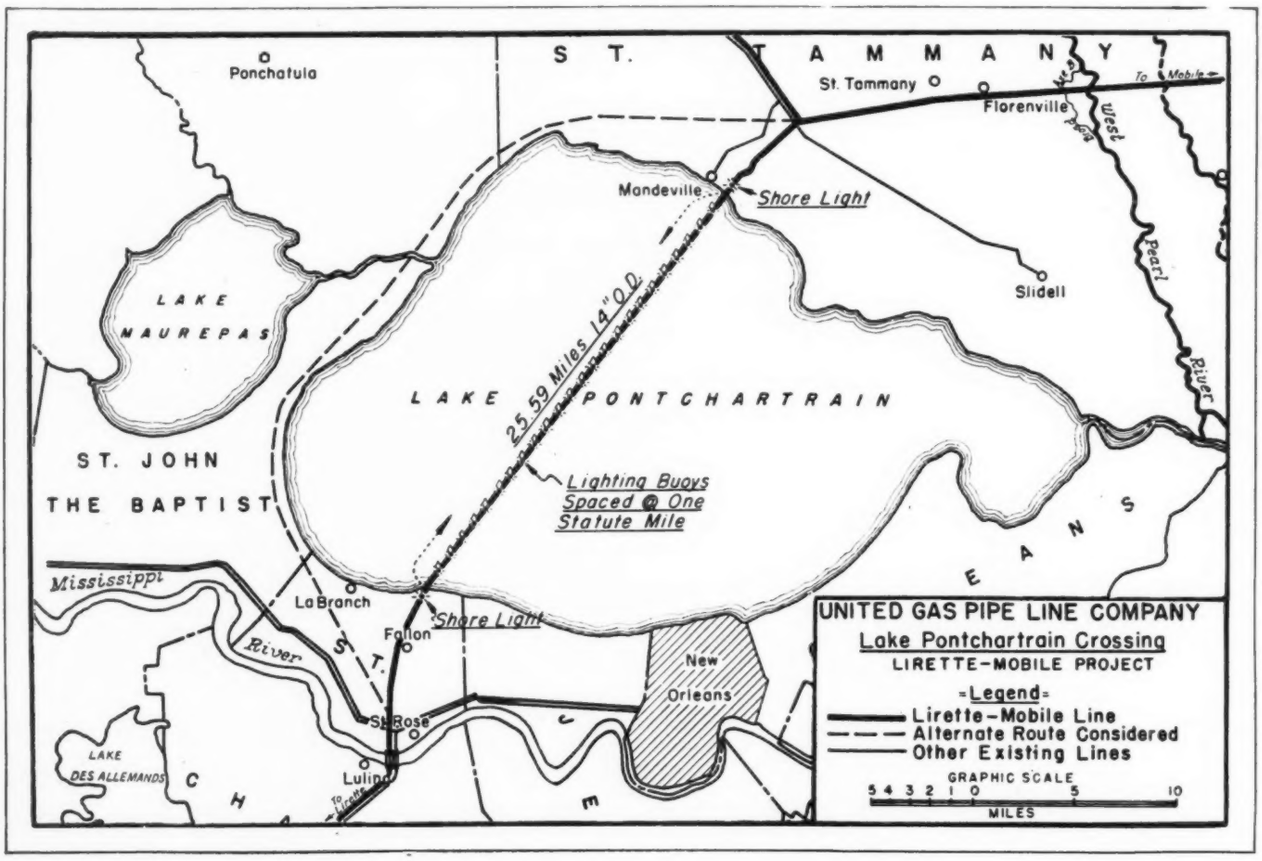
The final decision as to the type of protective coating used was made on the basis of two factors, namely, protection and additional weight inasmuch as 72-lb. bare pipe displaced 67-lb. of water per linear ft. The 5-lb. differential was not deemed sufficient to insure a stable line during storms in such a shallow body of water. The coating chosen was an asphalt-mastic, ⅝ in. thick, weighing 25 lb. per linear ft. The resultant weight of pipe plus coating gave a positive weight in water of 18 lb. per linear ft., which was considered sufficient to insure a stable line at all times without the use of conventional river weights. The coating was an intimate mixture of asphalt, sand, lime dust, and asbestos fiber, applied to the pipe under pressure at high temperature. As the coated pipe left the application head of the coating machine it was cooled and coated with a whitewash solution that prevented the coating from absorbing excessive heat from the sun while on the welding racks. As additional protection against electrolytic corrosion, each terminal of the lake crossing was provided with insulated joints at the valve settings. The insulated joints consist of flange gaskets and insert sleeves of bakelite, the sleeves being used to insulate the bolts from the flanges. This added protection was considered necessary in order to protect the crossing against "long line currents" discharged within the lake. For potential testing purposes, five equally spaced test leads were installed on the line in the lake. The free end of each test lead was attached to a permanent buoy marker.

Construction Procedure

Construction procedure was divided into four main phases: coating, welding, towing, and laying.

All pipe for the crossing was delivered by rail to a coating yard at Mandeville, Louisiana. The site of the coating yard, selected because of trackage facilities and adequate space for racking both coated and uncoated pipe, was approximately one-half mile from the lake front. At this point, the pipe was delivered to the contractor responsible for applying the asphalt-mastic coating.

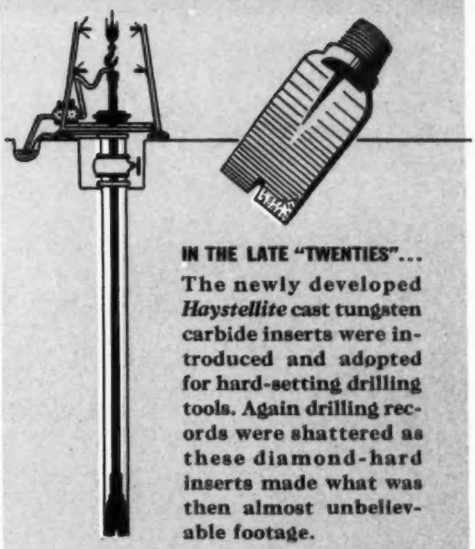
From the coating yard the pipe was moved by truck in single joint sections averaging 43 ft. in length to the welding yard. Roll welding in two-joint sections on racks padded to protect



Vicinity map of Lake Pontchartrain crossing

Haynes Stellite Products
for more efficient drilling tools

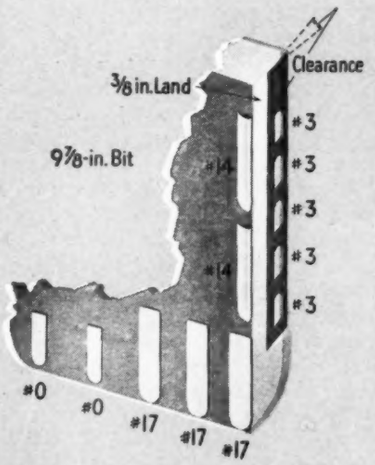
IN THE EARLY "TWENTIES"...
Haynes Stellite Company introduced the practice of hard-facing oil well drilling bits with *Haynes Stellite* rod—and fishtail bits hard-faced with this non-ferrous alloy soon were making unprecedented drilling records in oil fields everywhere.



IN THE LATE "TWENTIES"...
The newly developed *Haystellite* cast tungsten carbide inserts were introduced and adopted for hard-setting drilling tools. Again drilling records were shattered as these diamond-hard inserts made what was then almost unbelievable footage.

IN THE "THIRTIES"...
It became general practice to set *Haystellite* inserts with High-Test Steel rod, and then to hard-face with the new *Haystellite* tube rod. This new product—crushed particles of tungsten carbide in a high-test steel tube—was developed to provide a high degree of all-over abrasion-resistance. These high-quality materials, plus improvements in the technique of applying them, continued to improve drilling performance.

17 YEARS OF DRILLING RECORDS



Shown above is a typical application of Haystellite inserts.

AND IN THE "FORTIES"... Bits hard-set with *Haystellite* inserts and hard-faced with *Haystellite* tube rod are still making outstanding drilling records. As new types and sizes of bits have been developed, Haynes Stellite Company has brought out additional sizes and shapes of uniformly hard and tough Haystellite inserts to fit them. Constant research work on hard-setting and hard-facing materials and on methods of applying them assures continued progress in the future.

For outstanding drilling performance and more footage of out-to-gauge hole per round trip, use the slight extra care required to make each bit the most efficient it can be made—and use the best materials available. We have the products, the experience, and the organization to help you do this. Call on us.

HAYNES STELLITE COMPANY
Unit of Union Carbide and Carbon Corporation

General Office and Works:
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UCC

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HAYSTELLITE
TRADE MARK
Cast Tungsten Carbide Diamond Substitute

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A tow comes up to the welding barge in mid-lake

the coating was first attempted. This method of welding was shortly discontinued in favor of position welding due to the extreme difficulty of rolling such heavy, coated pipe (97 lb. per linear ft.) without injury to the coating.

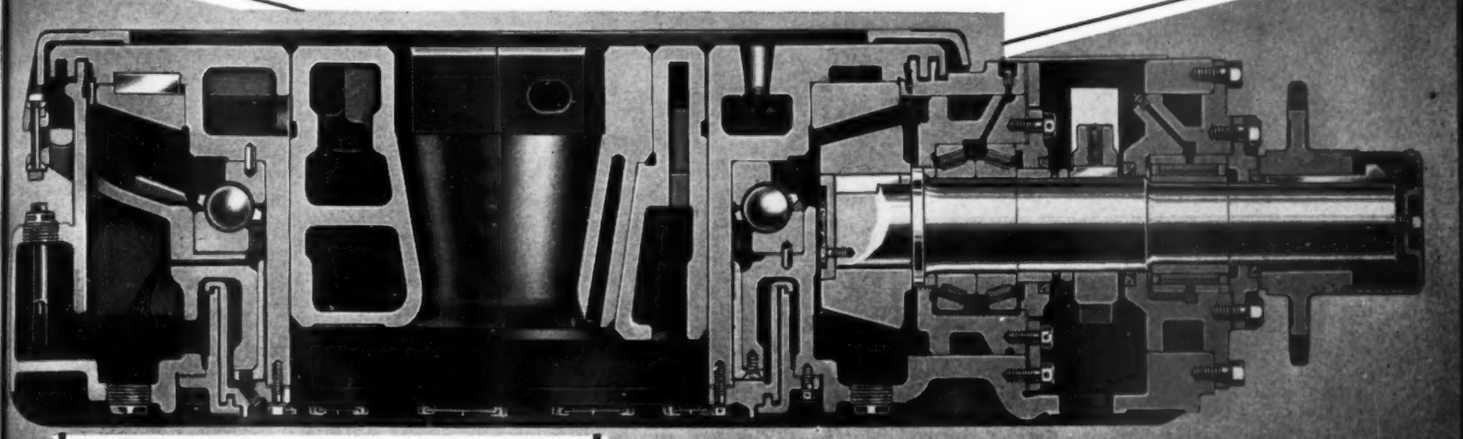
The original welding yard for horizontal fixed position welding was situated directly north of the shore line of the lake on the right-of-way. After operating for six days in this location the site was flooded and became unusable due to high tides caused by a tropical hurricane of medium intensity. Welding operations were moved to the baseball park at the edge of Mandeville on comparatively high ground. At this location the greater portion of the 135,000 ft. of 14-in. pipe was welded into 5-joint sections after each joint was coated. Welding operations progressed in two shifts. Two welders operated on each joint and the shielded-arc process of electric welding was used throughout. The ends of the pipe having a wall thickness of ½ in. were machine beveled to 30 deg. at the mill for welding in accordance with A.P.I. pipe line standards. The field welds comprised seven beads as follows: beads 1 and 2 were made with 5/32-in. rod, and beads 3 to 7, inclusive, were made with 3/16-in. rod. The average weld required nine 5/32-in. rods and twenty-seven 3/16-in. rods. As each field weld was completed it was immediately coated with a field joint of the asphalt-mastic coating.

From the welding yard the 5-joint welded sections (approximately 200 ft. of 14-in. pipe) were moved by two D-7 side-boom tractors to a point on the lake front some 800 ft. distant. At this point a ditch, with its bottom 12 to 18 in. below the water level of the lake, had been dug landward at right angles to the shore line, approximately 400 ft. Here the 5-joint welded sections were bellhole welded into a continuous welded string of pipe, 2200 to 2400 ft. in length, preparatory to towing into the lake for laying and tying-in on the final location. As each 200-ft. section of pipe was welded to the tow, the section was progressively moved into the lake by means of the tractors and a tug boat. In order to facilitate operations, each end of the 2200 to 2400-ft. string of pipe was supported on a pair of steel pontoons —each 4 ft. in diameter by 22 ft. long. The pipe string was made water-tight by attaching a "night cap," fabricated from a bolted coupling having a steel plate welded on one follower ring, to each end. As a final precaution, a 42-in. by 72-in. steel buoy was attached to each end of the pipe string with approximately 20 ft. of steel cable. These buoys served to mark the position of the pipe string in the lake in case a sudden storm made it necessary to cut loose the pontoons while towing the pipe.

The mechanics of the towing operations were comparatively simple. Upon completion of a pipe string, preparatory to towing, two Diesel tugs, one 300 hp. and one 400 hp., were attached in tandem by heavy manila towing cables to the pipe. As only the ends of the tow were completely floated by pontoons, added power from the beach in the form of the tow tractor and crane was necessary to move the string. Once under way the tows moved into the lake at speeds varying from 3 to 5 miles per hour, depending upon the length of the tow, direction and velocity of the wind, and the condition of the lake surface.

Laying operations were more complicated. The first string of pipe was landed as nearly as possible in the center of the lake. From this point, construction progressed toward the south shore for approximately five miles; after which, as the prevailing winds were such that the north shore was comparatively calm, pipe was laid from the center toward the south shore as weather and wind permitted. The laying operations consisted of towing each 2400-ft. string to the free end of the line, aligning this string of pipe along the staked survey, and finally welding the two free ends together. The free end of the line as laid was placed in heavy saddle clamps on a laying barge by means of the derrick barge operating alongside and over the laying barge. One end of the string of pipe to be attached was towed alongside the laying barge. The derrick barge "boomed out" over the laying barge, picked the end of the pipe tow off the pontoons and placed it in the saddle clamps on the laying barge where final alignment of the two ends was completed and the tie-in weld made. Upon completion of the weld, the joint was coated with asphalt-mastic and field patches of the same material were used to repair any coating that had been damaged in handling on the barge. Upon completion of this operation, the derrick barges picked the pipe free of the

Here's why your driller prefers "OILWELL" Rotaries



Constant and Ample Lubrication

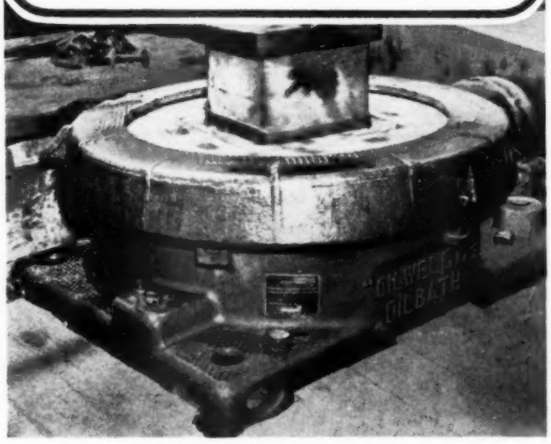
is the best assurance of long, efficient life. Illustrated in solid orange is the continuously circulating oilbath lubrication of the "Oilwell" 27½-A and 17½-inch Oilbath Rotaries. Oil picked up by the pinion and thrown from the gear is conducted by troughs in a steady stream to the main bearing. Part of the flow continues through the radial and hold-down bearing, keeping it constantly immersed in a shock-absorbing oil-cushion. Overlapping of the hold-down ring and oil-retainer ring insures complete return of the lubricant as it continues its circulating flow back to the reservoir.

Time-proved labyrinths at both the top and bottom effectively seal the oilbath enclosure and prevent intrusion of foreign matter. Shaded orange illustrates the separate lubrication of the pinion-shaft roller bearings in their sealed enclosures.

To maintain a constant oil pressure at the extreme speeds (up to 1000 r.p.m.) for which it is designed, the "Oilwell" 21-inch Super-Speed Rotary is provided, in addition to the splash system, with forced-feed lubrication throughout, including pinion shaft roller bearings.

. . .

"Oilwell" 17½-inch Oilbath Rotary.



IN times of emergency, rotaries, like men, are counted on to stand up and render efficient, reliable service as long as the need exists. Performance records show that "Oilwell" Rotaries have what it takes in reserve capacity, durability and *lasting* efficiency. Here are some of the reasons for this performance:

★ **Ample Capacity**

	17½-inch Oilbath	21-inch Super-Speed	27½-A Oilbath
Rated Drilling Depth	7,500 ft.	17,000 ft.	17,000 ft.
Dead Load Capacity	200 tons	300 tons	300 tons
Max. Table Speed	400 r.p.m.	1,000 r.p.m.	400 r.p.m.

★ **Fully heat-treated, spiral-bevel gear and pinion with the pinion given an additional surface hardening.**

★ **High-speed, self-centering, angle-contact main bearing with large-diameter, high-precision balls and through-hardened and ground high-carbon, alloy-steel races.**

★ **Heavy-duty bronze radial and hold-down bearing.**

★ **Compact and sturdy unit-assembly of the fully heat-treated pinion shaft, its bearings, bearing housings and locking wheel.**

★ **Rigid cast-steel base with integral skids, table enclosure, and cylindrical supports for the pinion-shaft bearings.**

★ **Constant and ample lubrication — see illustration and description.**

OIL WELL SUPPLY COMPANY

One of the long pipe sections being moved into the lake

welding barge, a tug moved the barge free of the pipe, and the line was lowered to the lake bottom. The tugs then moved the laying equipment ahead 2400 ft., placed the free end of the pipe in the saddles on the welding barge preparatory to making the next tie-in, thus completing the normal cycle of laying operations.

Construction Progress

Although September is known as a "hurricane month" in south Louisiana, pipe deliveries could not be made before the last week in August. Surveys were completed during the late spring and early summer of 1941 and arrangements made for the required governmental permits. By the time pipe was received the route of the line had been surveyed across the lake and marked with flags and buoys preparatory to actual construction.

The first pipe was received at Mandeville on August 28, 1941. Coating operations began on Tuesday, September 2, welding operations three days later, and on September 6 the first string of pipe was towed into place in the lake. Forty-five days after the first string of pipe was laid, the lake crossing was completed. During this 45-day construction period three storms, one of "hurricane" force, caused a total of 13 days lost time—days on which all small craft were ordered off the lake by the Coast Guard.

This project was engineered and inspected by the United Gas Pipe Line Company's regular forces, and constructed by Brown and Root, Inc.

☆☆☆

MAJOR EQUIPMENT USED ON LAKE CROSSING

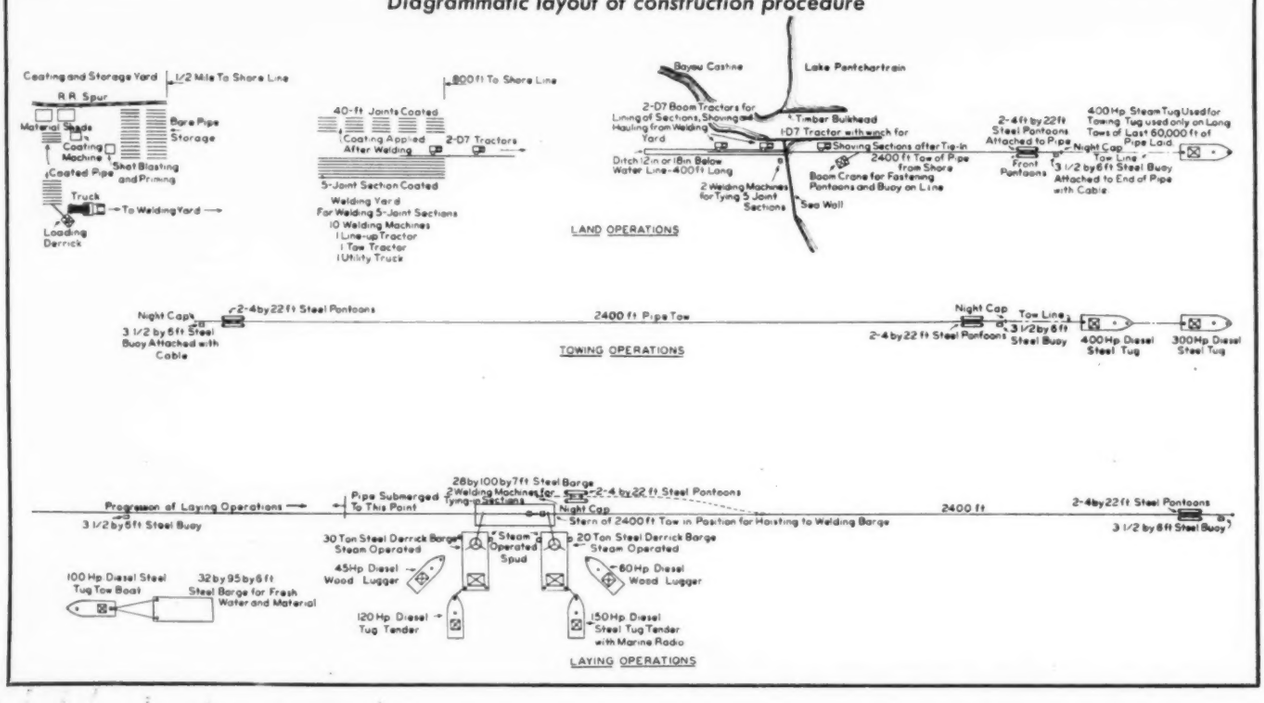
Yard welding operations
- 10—welding machines
- 1—D-6 line-up tractor
- 1—tow tractor
- 1—utility truck

Land operations—assembling tows
- 2—welding machines
- 2—D-7 side-boom tractors for line-up and shoving operations
- 1—⅜-yd. crane for attaching pontoons to pipe tow

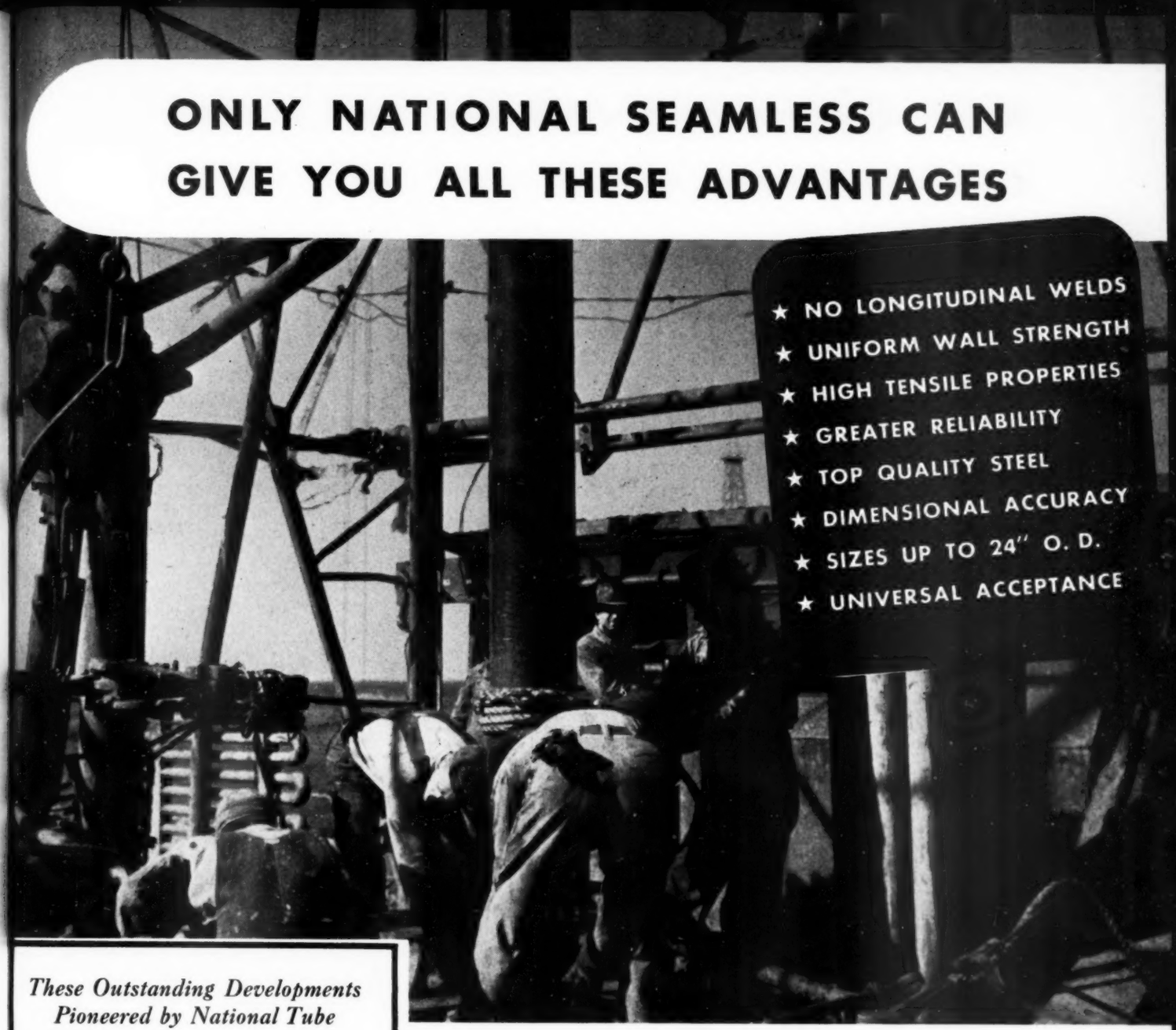
Towing operations
- 1—400-hp. Diesel tug
- 1—300-hp. Diesel tug
- 1—400-hp. steam tug

Laying operations
- 1—28-ft. by 100-ft. by 7-ft. pipe-laying barge
- 1—30-ton steam-operated derrick barge
- 1—20-ton steam-operated derrick barge
- 1—150-hp. steel tug tender with marine radio
- 1—120-hp. steel tug tender
- 2—welding machines for tie-in welds
- 1—60-hp. lugger for asphalt-mastic joint coating and patching operations
- 1—100-hp. steel tug
- 1—32-ft. by 95-ft. by 6-ft. steel material and fresh water barge
- 3—125-hp. speed boats (hauling crews and supplies)
- 1—125-hp. lugger

Diagrammatic layout of construction procedure


Coating and Storage Yard
1/2 Mile To Shore Line
R.R. Spur
Material Shade
Bare Pipe Storage
Coating Machine
Coated Pipe
Shot Blasting and Priming
Truck
To Welding Yard
Loading Derrick
800 ft To Shore Line
40-ft. Joints Coated
Coating Applied After Welding
2-D7 Tractors
5-Joint Section Coated
Welding Yard For Welding 5-Joint Sections
10 Welding Machines
1 Line-up Tractor
1 Tow Tractor
1 Utility Truck
Bayou Castine
Lake Pontchartrain
2-D7 Boom Tractors for Lining of Sections, Shoving and Hauling from Welding Yard
Timber Bulkhead
D7 Tractor with winch for Shoving Sections after Tie-in
Ditch 12 in or 18in Below Water Line-400 ft Long
2400 ft Tow of Pipe from Shore
Boom Crane for Fastening Pontoons and Buoy on Line
2 Welding Machines for Tying 5 Joint Sections
Sea Wall
LAND OPERATIONS
2-4 ft by 22 ft Steel Pontoons Attached to Pipe
Front Pontoons
Night Cap
Tow Line
3 1/2 by 6 ft Steel Buoy Attached to End of Pipe with Cable
400 Hp. Steam Tug Used for Towing. Tug used only on Long Tows of Last 60,000 ft of Pipe Laid
Night Cap
3 1/2 by 6 ft Steel Buoy Attached with Cable
2-4 by 22 ft Steel Pontoons
2400 ft Pipe Tow
Night Cap
2-4 by 22 ft Steel Pontoons
Tow Line
3 1/2 by 6 ft Steel Buoy
400 Hp. Diesel Steel Tug
300 Hp. Diesel Steel Tug
TOWING OPERATIONS
Progression of Laying Operations
3 1/2 by 6 ft Steel Buoy
Pipe Submerged To This Point
28 by 100 by 7 ft Steel Barge
2 Welding Machines for Tying-in Sections
2-4 by 22 ft Steel Pontoons
Night Cap
Stern of 2400 ft Tow in Position for Hoisting to Welding Barge
2400 ft
2-4 by 22 ft Steel Pontoons
3 1/2 by 6 ft Steel Buoy
30 Ton Steel Derrick Barge Steam Operated
Steam Operated Spud
20 Ton Steel Derrick Barge Steam Operated
45 Hp. Diesel Wood Lugger
60 Hp. Diesel Wood Lugger
100 Hp. Diesel Steel Tug Tow Boat
32 by 95 by 6 ft Steel Barge for Fresh Water and Material
120 Hp. Diesel Tug Tender
150 Hp. Diesel Steel Tug Tender with Marine Radio
LAYING OPERATIONS

ONLY NATIONAL SEAMLESS CAN GIVE YOU ALL THESE ADVANTAGES

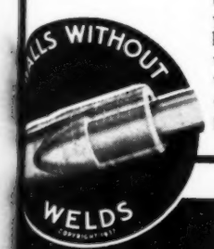

★ NO LONGITUDINAL WELDS
★ UNIFORM WALL STRENGTH
★ HIGH TENSILE PROPERTIES
★ GREATER RELIABILITY
★ TOP QUALITY STEEL
★ DIMENSIONAL ACCURACY
★ SIZES UP TO 24" O. D.
★ UNIVERSAL ACCEPTANCE

These Outstanding Developments Pioneered by National Tube

Seamless Drill Pipe
Seamless Upset Tubing
Seamless Long Threads and Couplings
Seamless Grade "D" *Casing (now J-55), also Grade "D" Drill Pipe and Tubing
Seamless Upset Casing
Seamless with Round Form of Thread
Seamless with Electro-Galvanized Coupling Threads
Seamless Normalized Tubing for Corrosive Conditions
Seamless Cement-Lined Casing and Tubing

*NATIONAL Seamless Casing is available in sizes up to 24" O.D., the only seamless casing larger than 16" O.D.

NATIONAL SEAMLESS means pierced from solid billets of finest quality steel. Only sound and flawless steel can be successfully pierced, since any defects in the steel are certain to be exposed by this process. At every stage in production, thorough tests and inspections redouble your assurance that every length of NATIONAL Seamless will display the same uniform wall strength, dimensional accuracy and uniformity in all physical properties.



THE combination of advantages possessed by NATIONAL Seamless puts it at the top of the list among experienced operators. Proof of this recognition is the fact that throughout the oil fields, NATIONAL Casing, Tubing, and Drill Pipe are chosen for more tough jobs than any other material. That's why NATIONAL shows up so often on record-breaking runs. Under such conditions, drillers want proved reliability and naturally pick the product that offers all the best features.

Reliability in seamless is the direct result of the method of manufacture — namely, piercing a solid billet of steel to obtain a tube of uniform wall strength without a longitudinal weld. No method of joining metal to make a tube has yet been devised that can equal these advantages of seamless.

Why experiment with any but the finest that industry can produce? Remember, only NATIONAL Seamless can give you *all* the above advantages. Standardize on NATIONAL Seamless — "Walls Without Welds" for your Oil Country Tubular needs. Write for a copy of Bulletin No. 15.

NATIONAL TUBE COMPANY

PITTSBURGH, PA.

United States Steel Export Company, New York

UNITED STATES STEEL

NATIONAL SEAMLESS *Walls without Welds*

Drilling Practices*

☆ A brief review of the more important operating problems with which the drilling contractor must contend

by C. W. DeLancey

Assistant Superintendent, Gulf Coast Division, Humble Oil and Refining Company

THE oil industry in its short period of existence has established an enviable record. This year it celebrated the 40th anniversary of the Lucas Gusher that opened prolific production in the Southwest. From this humble beginning the industry has expanded in size to second in the nation. Its products are made available to our factories, our homes, and on the highways. Its by-products are rapidly increasing in importance as basic material for other industries. The pride and satisfaction of accomplishment each of us derives from being a part of this great industry, is shared equally with the oil-well contractor. It is significant that the Lucas Gusher was drilled by a contractor.

The contractor is a specialist in drilling wells. The time required to drill a well is measured in days as compared with years of expected producing life under present restricted rates of withdrawal. It would not be possible for the small operator to obtain the skilled help or advisable to own the equipment when both men and equipment would be idle a large part of the time. Likewise, larger operators have varied development programs that make it advisable to contract all, or part, of their drilling. The contractor, therefore, is performing a real service to the industry and the security of his position will be limited largely by his ability to meet the requirements of the operators.

The Operator's Requirements

What are some of the requirements? Foremost—but seldom mentioned—is the contractor's reputation for honest and fair dealings. We all know how difficult it is to anticipate the problems that may arise in the drilling of wells and to define the responsibility of each party in terms of a written contract. It is, therefore, important that each party has that confidence in the other that will enable him to make adjustments to the satisfaction of both. The contractor's use of adequate equipment is taken for granted. The operator is also concerned that competent, skilled workmen will be employed who will use such methods as will result in a safe, economical, and rapid completion. It is with such practices and methods that we are now concerned.

*Presented before First Annual Meeting of American Association of Oilwell Drilling Contractors, Dallas, Texas, November 14, 1941.

C. W. DeLANCEY

graduated from Tri State College in 1915 with B.S. and A.B. degrees—Spent the following four years teaching—Was employed by Humble Oil and Refining Company in 1919, and has served in various capacities of the production department since that time—At present is assistant superintendent of the Gulf Coast Division.

Preventing Blowouts

Perhaps the fear of a blowout is the greatest mutual concern. If this occurs the operator may lose part of his mineral reserve, and the contractor certainly may lose the hole and possibly most of his rig. Preventer equipment now available is adequate if properly maintained. From studies to determine the causes of wild wells, it is evident that poor judgment, lack of skill in operating the equipment, and improper maintenance far outnumber the cases of material failure. Doubtless we have all been present when it became necessary for the driller to close the preventers and pump under restricted flow. Perhaps a ½-in. choke was used and the slush pumps opened wide with the resultant loss of mud into the formation. The same driller had completed producing wells and was familiar with rates of flow under similar chokes and pressures yet he failed to associate the information with the present problem to check his judgment. Recently, a person was confident that his equipment was in condition to work on a well, yet when it was suggested that the preventers be given a pressure test before proceeding with the work, he found it necessary to send them to a shop for overhaul. Clearly, a case of improper maintenance. Therefore, to be certain that failures do not occur, it is a good policy to require each crew to operate the preventer equipment once during their respective tours.

Top control equipment will not be effective unless the casing to which it is attached is in good condition. Crooked kellys and eccentric motion of the rotaries are the chief causes of excessive wear near the surface. It is safe to assume that a motion similar to that of the swivel and tackle will occur under the rotary. In fact, it may be amplified in a manner similar to that of a rope artist wherein a slight motion of the wrist is increasingly amplified in the rope. A study of wear was made in casing recovered from abandoned wells and it was found that the point of greatest wear was not in the top joint, but between 100 to 200 ft. below the surface.

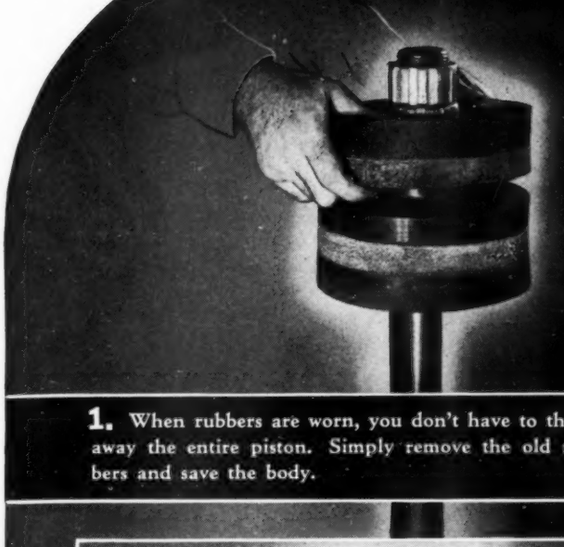
On wells where conductor pipe is not used, and where it is not possible or advisable to cement the surface casing to the top, many operators have found it advisable to cement the top 100 ft. in order to prevent sag and vibration. This can be done with small expense while the cementing equipment is on location.

Stuck Drill Pipe

Although bits remain fairly well to gauge and better mud is used, drill pipe does become stuck, usually at the drill collars. If this occurs while the pipe is being raised or lowered, the

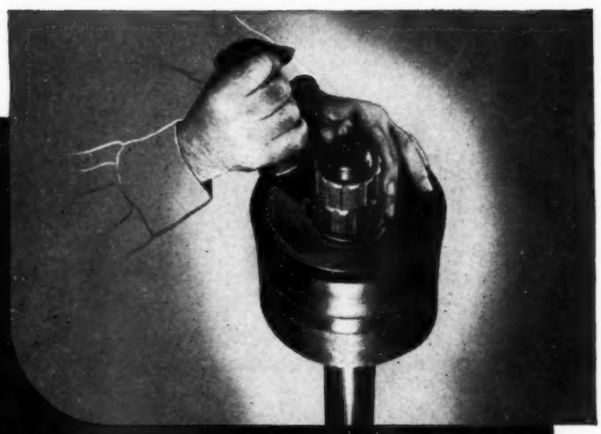
MISSION SLUSH PUMP PISTONS

Change The Rubbers and CONSERVE METALS



1. When rubbers are worn, you don't have to throw away the entire piston. Simply remove the old rubbers and save the body.

2. It's not even necessary to remove the piston body from the rod. You save on shut-down time when rubbers are changed.



3. NOW new Mission Rubbers are installed and the piston is ready for another long run at a fraction of the cost of a new piston.

The Mission principle of "Changing The Rubbers and Saving The Piston Body" has been an economy feature for many years. This saving of steel by using the same piston body over and over again assumes even greater importance at this time when metal conservation is a vital concern.

A Mission Piston lasts longer than an ordinary piston. When rubbers finally wear out, they are replaced at much less than the cost of a complete new piston.

For saving money, reducing trouble, and conserving steel, standardize on Mission Pistons. Order them from your favorite supply store.

MISSION MANUFACTURING CO.

HUMBLE ROAD HOUSTON, TEXAS

EXPORT OFFICE: 30 ROCKEFELLER PLAZA, NEW YORK

driller should try to free it in the direction opposite to travel at the time of sticking. Circulation should be attempted largely because it may give a clue as to the cause of sticking and the method best suited to free the pipe. If circulation is obtained it may be advisable to wash free with water or oil in such cases where no gas is present. I know of no case where serious caving occurred while washing even several hours with oil or water provided that arrangements were made for remudding the hole without stopping circulation. Acid probably has the least application because of cost, availability, and harmful effect on mud.

Inasmuch as pipe usually sticks near the drill collar assembly, it has become a general practice to install a safety joint at, or near, that point. Of necessity, the joint is designed with loosely fitting threads and because of this fact, some failures have occurred. It is probably advisable to run the safety joint one joint above the drill collars to procure flexibility between it and the stiff collar assembly and at the same time retain the advantage of having the minimum amount of assembly to recover by wash-over or other means.

The driller should always bear in mind that the function of a safety joint is to provide a means of quickly freeing a large part of the drill pipe and to prevent further sticking until necessary tools have been obtained and a satisfactory plan has been adopted.

Perhaps more thought should be given to selecting the proper tools for reaming as based on an analysis of the objective to be attained. Neglecting undersize hole caused by dull bits, reaming may be done to prepare the hole for casing and cement, to remove bridges, and to correct keyseats.

Most of us believe it is desirable to remove coarse, undissolved cuttings and filter cake from that section of the hole to be cemented, before oil strings are run. For this purpose a pilot rock bit seems especially well suited because there is very little danger of sidetracking the hole, also, reduced hole can be enlarged without making an extra trip, and that mud cuttings are forced past the bit body at high velocity.

Bridging

In areas of soft formation bridging sometimes occurs near the surface. It is desirable to remove such bridges with the least chance of sidetracking. As they are usually encountered while going in the hole with full size bit, there is a temptation to immediately begin reaming. It is much safer to wash through the obstruction without rotation. If this is not successful, then it is reasonably safe to rotate provided the rate of bit penetration is maintained well above that possible when drilling in new hole. This speed may cause balling of the bit, which will necessitate the bit being worked up and down while off bottom until the ball is pumped free. A further attempt to auger through the bridge should then be made and if unsuccessful, a small bit without drill collars should be run.

Keyseating

Keyseating, caused by drill pipe wearing into side of well bore, presents an interesting problem. The extent of keyseating in a given formation will be nearly proportional to the component of force at right angle to the drill pipe as determined by the crookedness of the hole and the weight of pipe below that point, also, the length of time such force has been applied. Little, or no benefit will result from reaming when tools are run on bottom of the drill string as no force will be operative to force the reamer against the area to be enlarged. If the tools are placed approximately 1000 ft. above the bit, sufficient force will be available to obtain the desired result. No extra trips will be required to condition the hole if a type reamer is selected that requires no fluid to be discharged around the cutters. After the operation is concluded the drill string is run to bottom, drilling resumed, and the reamer removed on the next trip. The drill pipe must be made-up tightly and the rotary motion should be smooth to prevent backing-off of pipe that is suspended below the reamer.

The problem of keyseating becomes most pronounced while drilling deviated holes in soft formation. The above described procedure has been satisfactory in drilling 5500-ft. wells with horizontal displacement to 1000 ft.

Drill-Pipe Connections

With the advent of higher slush pump pressures, drill pipe connections are required to withstand greater differentials without leaking. Neither the manufacturer nor user will be satisfied until a joint is designed that will more nearly approach the expected service of the pipe to which it is attached, and which may be more economically repaired. Until such joints are available, small leaks will occur that if not quickly detected will cause fishing jobs. Most drillers are able to detect such leaks by counting pump strokes. At least one-half the wash-outs may be detected in time to prevent fishing jobs.

Cementing

Much excellent study has been given to the problem of obtaining satisfactory cement jobs in recent years, yet, much remains to be done. Yesterday we separated zones, today because of multiple completions, future workovers, thin sands, proper gas ratios, each vertical foot must be effectively sealed. Recementing requires time and is expensive. The present trend points to further investigation and use of mechanical devices attached to the casing that will remove filter cake and loose formation immediately ahead of the cement column. It is necesasry that we procure more data from workovers, and break down pressures in recement jobs to properly evaluate different appliances and methods.

Problem of the Oversize Hole

The industry is now becoming more conscious of the fact that oversize hole presents problems to be solved both in drilling and completing wells. Drill pipe may be crooked, or fail, with resultant difficult fishing jobs. Casing may part as a result of improper support, and additional quantities of cement are required. Even the electric logging technicians are concerned with the variable distance between electrode and well bore, and the mud-logging operator finds it necessary to use indicators to determine the time required for the mud to complete its cycle. A well in the Texas Panhandle was drilled to 4400 ft. where 9⅝-in. casing was set and cemented to the surface. It required nine times the calculated amount of cement to accomplish the purpose. A deviated hole being dug in the Gulf Coast is now under study. It became necessary to plug back to 2700 ft. and sidetrack in a desired direction. Difficulty was experienced in sidetracking and it was decided to caliper the hole. The 8⅝-in. hole when calipered measured between 10 in. and 20 in. The hole was plugged to permit the deflecting tools to operate in the 10-in. diameter section and the desired result was obtained. The original hole was dug with untreated mud whereas treated mud is being used in the sidetracked portion. At completion, data will be studied as revealed by electric and caliper logs of each section.

Well Measurements

All of us recognize the need of more accurate well measurements for successful completions. It has been demonstrated that a difference not to exceed 2 ft. between drill pipe and casing measurements in deep holes is within reason. Without describing any method of measuring casing in detail, it is evident that certain precautions are necessary. To permit a check at any stage of the operation, an inventory of the number of joints on hand should be made and as each joint is measured an identification number should be chalked on the pipe and also entered on the tally sheet. Allowance must be made for

PETROLEUM ENGINEER EDITION

BAASH ROSS News

BAASH-ROSS TOOL COMPANY, LOS ANGELES, HOUSTON, NEW YORK

A BULLETIN COVERING NEWS OF EQUIPMENT AND OPERATIONS IN THE PETROLEUM INDUSTRY

Inside Facts: HOW B-R FISHING TOOLS ARE ENGINEERED FOR POSITIVE RELEASE IN EMERGENCIES

Grip Alone is not Enough — A SAFE Grip is The Important Thing to Look For!

Ask an experienced oil man what are the most important features he wants in a spear or socket and he'll tell you . . .

First . . . I want to be mighty certain that, once I've taken a hold on a fish, I can get *off* again whenever I have to.

And . . .

Second . . . I want a tool that won't batter up the fish . . . nor bulge it . . . nor split it, preventing further operations.

And he's right. Because almost *any* spear or socket will catch hold of a fish. *But what happens AFTER it catches hold, is the important thing to look for.*

Which brings up one of the big reasons why Baash-Ross fishing tools are so downright dependable in *any* emergency—*at any depth.* They're engineered, not only to take *hold* of the fish, but to take a *safe* hold *and then to release again whenever necessary!*

▶ To show you just what we mean by "engineering" a tool for positive release, let's take a look at the Baash-Ross Rotary Releasing Spear. Unlike many spears, *all* of the releasing mechanism in this tool is completely BELOW the slips and out of the way of jarring and pulling operations. After you have taken hold of the fish you can jar the daylights out of it. You can pull. You can twist. *But not one bit of these strains is transmitted through the releasing device.* That's why it's always ready for release when you want to get off the fish.

▶ **But even** more important is the fact that the slips on this spear are *FLAT-backed* . . . and work against a FLAT-faced taper. This is one of the most important features ever built into a spear, and here's why . . .

In the usual construction of a *round*-backed slip working against a tapered cone, there is only ONE spot where the cone and the slip fit perfectly—just one point where the cone gives full backing to the slip. Above this point, only the outer edges of the slip touch the cone *and the entire center is unsupported.* Below this point, only the center of the slip touches the cone *and both of the sides are unsupported.* In either position, the result is the same. A stress is placed on the slip that tends to break it vertically down the center . . . and once you split your slips on a fishing job, you're lucky if you *ever* release!

▶ **To visualize** just what we're talking about, do this. Take a card, and, with a paper punch, punch out a half circle in one edge. Now hold that arc up against the cone-shaped point of an ordinary pencil. Notice that there's only ONE spot where that half circle fits the cone (fig. 1). Lift it above that spot and only the edges touch, leaving the center completely unsupported (fig. 2). Drop it below that spot and only the center touches, with both sides unsupported (fig. 3).

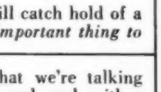


Fig. 1

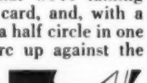


Fig. 2

Fig. 3

The principle is exactly the same on a full-length slip . . . which explains why ordinary *round* backed slips frequently break and jam when the going gets tough. In their "set" position the chances are against their having full support by the cone . . . and a heavy strain jams or breaks them.

▶ But the *flat* surfaces of the Baash-Ross Spear prevent this danger. The slips get maximum support regardless of how far up or down the taper they work. There is no risk of splitting the slips and freezing the tool no matter how hard you jar. Nor is there any danger of concentrating the slip pressure so as to damage or split the pipe. All the slips are unitized by an "alignment collar" . . . move as a single unit in gripping the pipe, thus insuring a *uniform* grip at all points.

There are still other important safety features built into this tool . . . features your nearest Baash-Ross representative will be glad to go over with you in detail. It will pay you to know about them when a fishing job comes along, so why not ask to have them explained now.

(Leased in U.S.A.—Sold for export only)

Unique Socket Design Insures Safe Grip on Fish

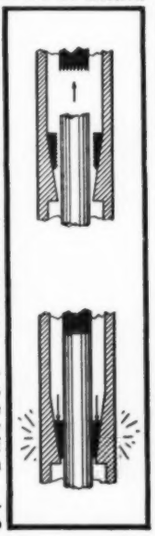
As every oil man knows, there are two kinds of fishing jobs . . . those where you catch the fish from the inside, and those where you catch it on the outside.

For an inside grip, the Baash-Ross Spear described at left is your safest bet. And when it comes to taking an *outside* grip on the fish, the tool to use for SAFE fishing is the **Baash-Ross "Type B" Rotary Releasing Socket.** Here's the reason . . .

Unlike conventional sockets, this socket is so engineered that you get a full, positive grip on the fish every time . . . a grip *automatically* spaced a short distance *below* the top of the fish where danger of crimping or bottlenecking the pipe is at a minimum.

This Is How It's Done:

As the Baash-Ross Socket descends over the top of the fish, there are no friction springs or dragging slips to interfere. Instead the slips remain fully retracted until the top of the fish is *completely into the socket.*



When completely in, the fish contacts the sharp-toothed face of the slip holder and—by holding this part against rotation—permits the slips to be released. Then, as the tool is lifted slightly, the slips are automatically forced into gripping contact by the pressure of a coil spring.

This important operating safeguard insures easier entrance of the fish . . . and practically eliminates all chance of catching the fish with only a partial grip.

Furthermore, it insures a full-length grip taken *below* the top of the fish where danger of crushing the pipe is far less than at the top.

▶ This is why the Baash-Ross Socket will not deform the fish—because it takes its grip where the pipe is solid and able to withstand heavy pulling and jarring strains.

Another thing. In this B-R Socket each of the three slips is joined at the top into one unit. They move as a unit, grip as a unit, to give you an equally-balanced grip all the way around the fish. This protects against slip breakage . . . prevents them from "crawling" and chewing the pipe, thus insuring quick, clean release the instant it is desired. And the slips can be repeatedly set and released as often as desired without coming out of the hole.

Next time you're in need of fishing equipment remember that with Baash-Ross tools you can always be sure of a good solid grip that won't deform the pipe . . . and you can be equally sure of positive release no matter how long or hard you jar. These tools are *engineered* that way!

(Leased in U.S.A.—Sold for export only)

MANY OPERATORS BELIEVE that some of the success attributed to spotting oil to free pipe is actually due to alternate starting and stopping of pumps during this operation. Therefore, before resorting to oil spotting, such operations as starting and stopping pumps and "water hammer" should be given a thorough trial.

B A A S H - R O S S

INCIDENTALLY, have you tried spotting *water* to free pipe, instead of spotting oil? Many operators prefer it, especially if mud is composed of costly admixtures, for oil has a ruinous effect on mud. Procedure is to pump clear water from suction pit into well and divert mud thus displaced into the reserve pit. Water has been used for this operation for as long as six hours without damaging hole walls.

B A A S H - R O S S

WHEN DRILLING IN CAVING or heaving formations where pipe can stick easily, it's a good idea to place a safety joint in the string just above where caving is liable to occur. Should the pipe freeze, the string can be quickly disconnected at the joint and pulled out of the hole. Baash-Ross has recently developed a new drilling type Safety Joint that's just the thing for this.

B A A S H - R O S S

FREQUENTLY, FISHING JOBS are caused by the use of tapered drill collars in a key-seated hole. The collar can become stuck so tightly because of its wedging action that it cannot be spudded or rotated loose. However, running a square-shouldered sub on top of the collar—equal in diameter to the largest diameter of the collar taper—has been found to be an effective safeguard against this trouble.

variable sewage that can be done by scratching the pipe 1 in. above the base of threads and measuring the distance exposed from that point to top of coupling after joint has been made tight. There are many slips between the tape and the adding machine. It is easy for the reader to call 31.02 and the recorder to write 32.01. We should take a tip from the banker; he counts his money twice. We should check all our measurements before the pipe goes into the ground.

Mud Treatment

The history of mud treatment is interesting in that it clearly reminds us that the solution of one problem frequently indicates another to be solved. The first objective in mud treatment was to reduce viscosity in order to release occluded gas, remove cuttings, and obtain a more pumpable fluid. From continued study it became evident that filtration of water into the surrounding formation might be partly responsible for such troubles as stuck pipe, poor cement jobs, oversize hole, and heaving shale.

Even a partial solution of such problems required the accumulation and study of much data by the technical and research men. They in turn reduced the method of treatment to such routine that average muds are now treated by the drilling crew along with their regular duties. To their tools, the centrifuge, hydrometer, and viscosimeter, have been added the filter press and titration papers, along with an explanation of the basic principles involved.

To further improve our methods, it is necessary to accumulate and study much data. Many groups are participating in this endeavor. You as contractors will drill approximately 75 percent of the 30,000 wells next year in the United States. Your obligation is, therefore, evident.

To you there is nothing new in this discussion. Each of you has had years of experience. The trade journals are sources of information for all who will read and study. It is not enough that you are well versed in the principles and methods involved; it is more important that your knowledge, experience and viewpoint be passed on to those working with you. Somehow you must devise means and contacts with your organization that will maintain interest and encourage further study on the part of each individual if our present rate of progress is to continue.

——☆☆☆——

P 641.1

Efficient Arrangement of Lease Tank Battery

WITH a little ingenuity exercised by the farm boss or pumper a lease tank battery can be made to operate more efficiently at relatively small expense. On a small battery in the southern portion of the Monument, New Mexico, oil field are evidences that some superintendent, farm boss, or pumper has been thoughtful of appearance as well as having a weather eye cocked toward convenience.

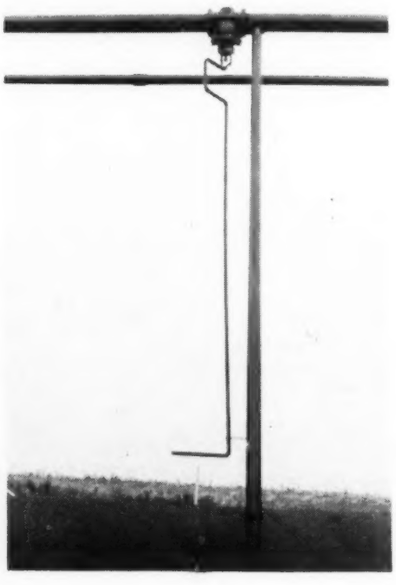
The battery containing three wooden tanks is enclosed by a well-maintained earthen dike, which is frequently oiled to prevent blowing of the sand. At the entrance to the battery, which is fenced, a rotating gate prevents entrance of livestock. The gate is made of pipe with four horizontal bars welded to a 4-in. pipe nipple supported in a slightly larger nipple set in the ground between the posts of the fence. So that sand will be prevented from sifting into the gate post bearings, part of a swage is welded that forms an apron or cover to prevent sand or other fouling material from entering the post.

On the 4-in. line running across the top of the three wooden tanks is a plug valve placed high to prevent tampering but which was formerly inaccessible except from a ladder. To facilitate operating this valve from the ground level, an extension handle was attached to the core with a wrench type sleeve secured by set screws. Because a 2-in. line is hung immediately below the 4-in., an offset bend was made into the plug extension handle that allows unobstructed operation of the valve, yet indicates to the operator whether the plug is open or closed.

Gauge poles laid across the top of tanks are prone to become warped and soon unfit for use. These are stored or racked at this tank battery on the railing of the walkway by means of hooks attached to the angle iron of the structure. The hooks are flat straps, shaped to hold the gauge pole without splintering or marring, and three are attached at proper intervals to keep the pole from warping when not in use.

Gate at entrance to tank battery that prevents livestock from passing; shield at lower end prevents sand from fouling post bearing

Extension handle facilitates operation of plug valve



THE *Petroleum* Engineer's CONTINUOUS TABLES

A DAILY REFERENCE FOR OPERATING MEN

INSTALLMENT No. 54

THE tables on the following pages are designed to save time and effort for the technician, and to assist the practical field or plant worker to solve problems commonly encountered in routine work. They are not intended nor expected to supplant technical training and make every man his own designer. Most of the tables can be understood and applied by anyone acquainted with the simple fundamentals of mathematics.

For the convenience of readers who wish to refer to the tables, each page carries in the upper right corner an index number that classifies the table according to subject matter.

All petroleum engineering literature may be indexed for reference according to the Dewey Decimal System as modified and extended for the petroleum industry by L. C. Uren, professor of petroleum engineering at the University of California. When classified according to these index numbers the material follows in a logical sequence and falls into several natural divisions, as illustrated by the following outline:

Nos. P000-P339—General
Nos. P400-P499—Drilling
Nos. P500-P599—Production
Nos. P600-P699—Transportation and Storage (includes Pipe Line)
Nos. P700-P799—Refining, including
Nos. P770-P799—Natural Gasoline, which may be classified in a separate division (as shown here) if of special interest to the user

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To aid the reader in using the Decimal System, a subject index arranged alphabetically has been published, and is available at a cost of 50 cents per copy from *The Petroleum Engineer*, P. O. Box 1589, Dallas, Texas.

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GRAVITY OF DRY OIL IN OIL-WATER MIXTURE

Gravity of "wet" oil deg. A.P.I.	Percent water in mixture														
	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
50.0	60.3	61.2	**62.0**	62.9	63.8	64.8	65.7	66.7	67.8	68.9	**70.0**	71.2	72.4	73.7	**75.0**
.1	.5	.4	.2	**63.0**	.9	.9	.9	.9	**68.0**	**69.0**	.2	.4	.6	.9	.2
.2	.7	.5	.4	.2	**64.0**	**65.0**	**66.0**	**67.0**	.2	.2	.4	.6	.8	**74.0**	.4
.3	.8	.6	.5	.4	.2	.2	.2	.2	.4	.4	.6	.7	.9	.2	.6
.4	.9	.7	.6	.5	.4	.4	.4	.4	.5	.6	.7	.8	**73.0**	.4	.8
50.5	**61.0**	61.8	62.7	63.6	64.5	65.5	66.5	67.5	68.6	69.7	70.8	**72.0**	73.3	74.6	75.9
.6	.2	.9	.9	.8	.7	.7	.7	.7	.8	.9	**71.0**	.2	.5	.8	**76.0**
.7	.4	**62.0**	**63.0**	**64.0**	.9	.8	.8	.8	.9	**70.0**	.2	.4	.7	**75.0**	.2
.8	.5	.2	.2	.2	**65.0**	.9	.9	.9	**69.0**	.2	.4	.6	.9	.2	.4
.9	.6	.4	.3	.4	.2	**66.0**	**67.0**	**68.0**	.2	.4	.6	.8	**74.0**	.4	.6
51.0	61.7	62.5	63.4	64.5	65.3	66.2	67.3	68.3	69.4	70.5	71.7	72.9	74.2	75.5	76.9
.1	.8	.7	.6	.6	.5	.4	.5	.5	.6	.7	.9	**73.0**	.4	.7	**77.0**
.2	.9	.8	.8	.7	.7	.6	.7	.7	.8	.9	**72.0**	.2	.6	.9	.2
.3	**62.0**	.9	.9	.8	.8	.8	.8	.9	.9	**71.0**	.2	.4	.8	**76.0**	.4
.4	.2	**63.0**	**64.0**	.9	.9	.9	.9	**69.0**	**70.0**	.2	.4	.6	**75.0**	.2	.6
51.5	62.3	63.2	64.1	**65.0**	**66.0**	**67.0**	**68.0**	69.1	**70.2**	71.3	72.5	73.8	75.1	76.4	77.8
.6	.5	.4	.3	.2	.2	.2	.2	.3	.4	.5	.7	.9	.3	.6	**78.0**
.7	.7	.6	.5	.4	.4	.4	.4	.5	.6	.7	.9	**74.0**	.5	.8	.2
.8	.8	.7	.6	.5	.5	.5	.6	.7	.8	.9	**73.0**	.2	.7	**77.0**	.4
.9	.9	.8	.7	.6	.6	.6	.7	.8	.9	**72.0**	.2	.4	.9	.2	.6
52.0	**63.0**	63.9	64.8	65.7	66.7	67.7	68.8	69.9	**71.0**	72.2	73.4	74.6	**76.0**	77.3	78.8
.1	.2	**64.0**	.9	.9	.8	.9	.9	**70.0**	.2	.4	.6	.8	.2	.5	**79.0**
.2	.4	.2	**65.0**	**66.0**	.9	**68.0**	**69.0**	.2	.4	.6	.8	**75.0**	.4	.7	.2
.3	.5	.4	.2	.2	**67.0**	.2	.2	.4	.6	.7	.9	.2	.6	.9	.4
.4	.6	.5	.4	.4	.2	.4	.4	.5	.7	.8	**74.0**	.4	.7	**78.0**	.6
52.5	63.7	64.6	65.5	66.5	67.4	68.5	69.5	70.6	71.8	**73.0**	74.2	75.5	76.8	78.2	79.7
.6	.8	.8	.7	.7	.6	.7	.7	.8	.9	.2	.4	.7	**77.0**	.4	.9
.7	.9	.9	.8	.8	.8	.8	.8	.9	**72.0**	.4	.6	.9	.2	.6	**80.0**
.8	**64.0**	**65.0**	.9	.9	.9	.9	.9	**71.0**	.2	.6	.8	**76.0**	.4	.8	.2
.9	.2	.2	**66.0**	**67.0**	**68.0**	**69.0**	**70.0**	.2	.4	.7	**75.0**	.2	.6	**79.0**	.4
53.0	64.3	65.3	66.2	67.2	68.2	69.2	70.3	71.4	72.6	73.8	75.1	76.4	77.7	79.2	80.6
.1	.5	.5	.4	.4	.4	.4	.5	.6	.8	.9	.3	.6	.9	.4	.8
.2	.7	.6	.6	.6	.6	.6	.7	.8	.9	**74.0**	.5	.8	**78.0**	.6	**81.0**
.3	.9	.8	.8	.8	.8	.8	.9	.9	**73.0**	.2	.7	.9	.2	.8	.2
.4	**65.0**	**66.0**	**67.0**	**68.0**	**69.0**	**70.0**	**71.0**	**72.0**	.2	.4	.8	**77.0**	.4	.9	.4
53.5	**65.0**	65.9	66.9	67.9	68.9	**70.0**	71.1	72.2	73.4	74.6	75.9	77.2	78.6	**80.0**	81.6
.6	.2	**66.0**	**67.0**	**68.0**	**69.0**	.2	.3	.4	.6	.8	**76.0**	.4	.8	.2	.8
.7	.4	.2	.2	.2	.2	.4	.5	.6	.8	**75.0**	.2	.6	**79.0**	.4	**82.0**
.8	.5	.4	.4	.4	.4	.5	.6	.8	.9	.2	.4	.8	.2	.6	.2
.9	.6	.5	.5	.5	.5	.6	.7	.9	**74.0**	.4	.6	**78.0**	.4	.8	.4
54.0	65.7	66.6	67.6	68.6	69.6	70.7	71.8	**73.0**	74.2	75.5	76.8	78.1	79.5	**81.0**	82.6
.1	.8	.8	.8	.8	.8	.9	.9	.2	.4	.7	.9	.3	.7	.2	.8
.2	.9	.9	.9	.9	.9	**71.0**	**72.0**	.4	.6	.9	**77.0**	.5	.9	.4	**83.0**
.3	**66.0**	**67.0**	**68.0**	**69.0**	**70.0**	.2	.2	.6	.7	**76.0**	.2	.7	**80.0**	.6	.2
.4	.2	.2	.2	.2	.2	.4	.4	.7	.8	.2	.4	.9	.2	.8	.4
54.5	66.3	67.3	68.3	69.3	70.4	71.5	72.6	73.8	**75.0**	76.3	77.6	**79.0**	80.4	81.9	83.5
.6	.5	.5	.5	.5	.6	.7	.8	**74.0**	.2	.5	.8	.2	.6	**82.0**	.7
.7	.7	.7	.7	.7	.8	.9	**73.0**	.2	.4	.7	**78.0**	.4	.8	.2	.8
.8	.9	.9	.9	.9	**71.0**	**72.0**	.2	.4	.6	.9	.2	.6	**81.0**	.4	.9
.9	**67.0**	**68.0**	**69.0**	**70.0**	.2	.2	.4	.6	.8	**77.0**	.4	.8	.2	.6	**84.0**

IN OIL WELL DRILLING AND PUMPING

★
★
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★
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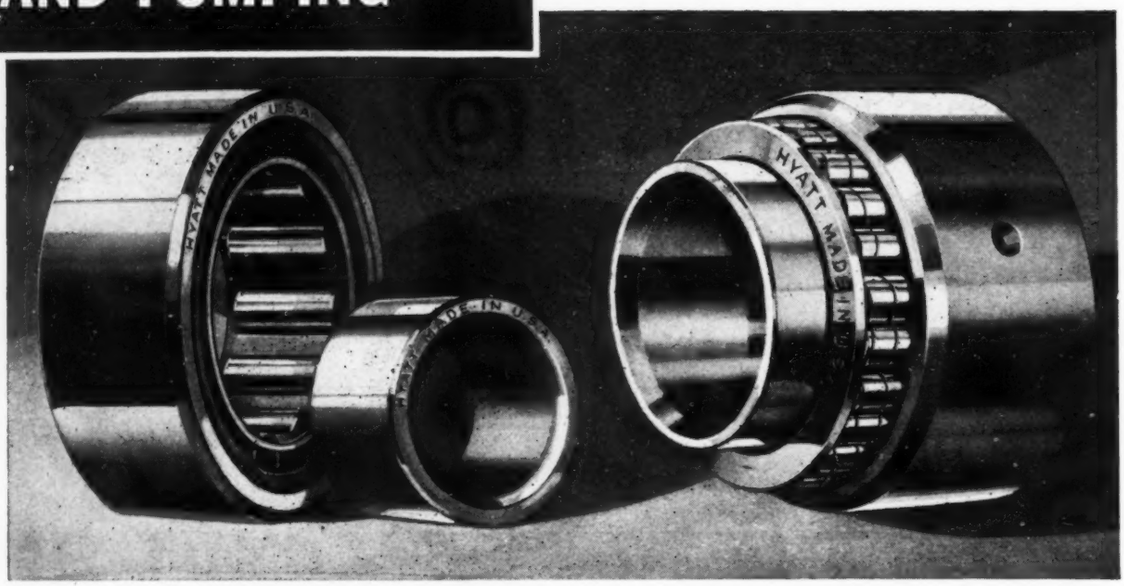

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WHEREVER wheels and shafts turn, Hyatt Roller Bearings are carrying the load ... cushioning the shocks ... minimizing friction ... and keeping equipment on the go.

That's why these precision bearings are today playing such a vital role in petroleum production, as well as in defense equipment and the machines which help build it. Hyatt Bearings Division, General Motors Sales Corporation, Harrison, N. J., Detroit, Chicago, Pittsburgh, San Francisco.

HYATT

ROLLER BEARINGS

QUIET

CUBE ROOTS OF WHOLE NUMBERS

	0	1	2	3	4	5	6	7	8	9
..	.....	1.000	1.260	1.442	1.587	1.710	1.817	1.913	2.000	2.080
10	2.154	2.224	2.289	2.351	2.410	2.466	2.520	2.571	2.621	2.668
20	2.714	2.759	2.802	2.844	2.885	2.924	2.963	3.000	3.037	3.072
30	3.107	3.141	3.175	3.208	3.240	3.271	3.302	3.332	3.362	3.391
40	3.420	3.448	3.476	3.503	3.530	3.557	3.583	3.609	3.634	3.659
50	3.684	3.708	3.733	3.756	3.780	3.803	3.826	3.849	3.871	3.893
60	3.915	3.937	3.958	3.979	4.000	4.021	4.041	4.062	4.082	4.102
70	4.121	4.141	4.160	4.179	4.198	4.217	4.236	4.254	4.273	4.291
80	4.309	4.327	4.345	4.362	4.380	4.397	4.414	4.431	4.448	4.465
90	4.481	4.498	4.514	4.531	4.547	4.563	4.579	4.595	4.610	4.626
100	4.642	4.657	4.672	4.688	4.703	4.718	4.733	4.748	4.762	4.777
110	4.791	4.806	4.820	4.835	4.849	4.863	4.877	4.891	4.905	4.919
120	4.932	4.946	4.960	4.973	4.987	5.000	5.013	5.027	5.040	5.053
130	5.066	5.079	5.092	5.105	5.117	5.130	5.143	5.155	5.168	5.180
140	5.193	5.205	5.217	5.229	5.242	5.254	5.266	5.278	5.290	5.302
150	5.313	5.325	5.337	5.349	5.360	5.372	5.383	5.395	5.406	5.418
160	5.429	5.440	5.451	5.463	5.474	5.485	5.496	5.507	5.518	5.529
170	5.540	5.551	5.561	5.572	5.583	5.594	5.604	5.615	5.625	5.636
180	5.646	5.657	5.667	5.677	5.688	5.698	5.708	5.719	5.729	5.739
190	5.749	5.759	5.769	5.779	5.789	5.799	5.809	5.819	5.829	5.838
200	5.848	5.858	5.868	5.877	5.887	5.896	5.906	5.916	5.925	5.935
210	5.944	5.953	5.963	5.972	5.981	5.991	6.000	6.009	6.019	6.028
220	6.037	6.046	6.055	6.064	6.073	6.082	6.091	6.100	6.109	6.118
230	6.127	6.136	6.145	6.153	6.162	6.171	6.180	6.189	6.197	6.206
240	6.215	6.223	6.232	6.240	6.249	6.257	6.266	6.274	6.283	6.291
250	6.300	6.308	6.316	6.325	6.333	6.341	6.350	6.358	6.366	6.374
260	6.382	6.391	6.399	6.407	6.415	6.423	6.431	6.439	6.447	6.455
270	6.463	6.471	6.479	6.487	6.495	6.503	6.511	6.519	6.527	6.534
280	6.542	6.550	6.558	6.565	6.573	6.581	6.589	6.596	6.604	6.612
290	6.619	6.627	6.634	6.642	6.649	6.657	6.664	6.672	6.679	6.687
300	6.694	6.702	6.709	6.717	6.724	6.731	6.739	6.746	6.753	6.761
310	6.768	6.775	6.782	6.790	6.797	6.804	6.811	6.819	6.826	6.833
320	6.840	6.847	6.854	6.861	6.868	6.875	6.882	6.889	6.896	6.903
330	6.910	6.917	6.924	6.931	6.938	6.945	6.952	6.959	6.966	6.973
340	6.980	6.986	6.993	7.000	7.007	7.014	7.020	7.027	7.034	7.041
350	7.047	7.054	7.061	7.067	7.074	7.081	7.087	7.094	7.101	7.107
360	7.114	7.120	7.127	7.134	7.140	7.147	7.153	7.160	7.166	7.173
370	7.179	7.186	7.192	7.198	7.205	7.211	7.218	7.224	7.230	7.237
380	7.243	7.250	7.256	7.262	7.269	7.275	7.281	7.287	7.294	7.300
390	7.306	7.312	7.319	7.325	7.331	7.337	7.343	7.350	7.356	7.362
400	7.368	7.374	7.380	7.386	7.393	7.399	7.405	7.411	7.417	7.423
410	7.429	7.435	7.441	7.447	7.453	7.459	7.465	7.471	7.477	7.483
420	7.489	7.495	7.501	7.507	7.513	7.519	7.524	7.530	7.536	7.542
430	7.548	7.554	7.560	7.565	7.571	7.577	7.583	7.589	7.594	7.600
440	7.606	7.612	7.617	7.623	7.629	7.635	7.640	7.646	7.652	7.657
450	7.663	7.669	7.674	7.680	7.686	7.691	7.697	7.703	7.708	7.714
460	7.719	7.725	7.731	7.736	7.742	7.747	7.753	7.758	7.764	7.770
470	7.775	7.781	7.786	7.791	7.797	7.803	7.808	7.813	7.819	7.824
480	7.830	7.835	7.841	7.846	7.851	7.857	7.862	7.868	7.873	7.878
490	7.884	7.889	7.894	7.900	7.905	7.911	7.916	7.921	7.926	7.932

Example: What is the cube root of 237?

Solution: On the line opposite 230 and under the column headed 7, the answer is found to be 6.189.

MEDART

Offers a Complete
Power Transmission Service
from a Single Source

A Complete Power Transmission Layout from a Single Source of Supply

A Service That Enables You To:

1. **Concentrate your purchasing and reduce interview time as much as 80 per cent.**
2. **Select a complete drive layout from a single responsible source . . . responsible for the efficient *over-all* operation of the drive.**
3. **Receive a complete drive installation in one shipment with one bill of lading to check . . . one invoice to post . . . one invoice to pay.**
4. **Receive the unbiased recommendation of power transmission engineers, who can lay out the drive best suited to *your* purpose because *they have a complete line to offer.***

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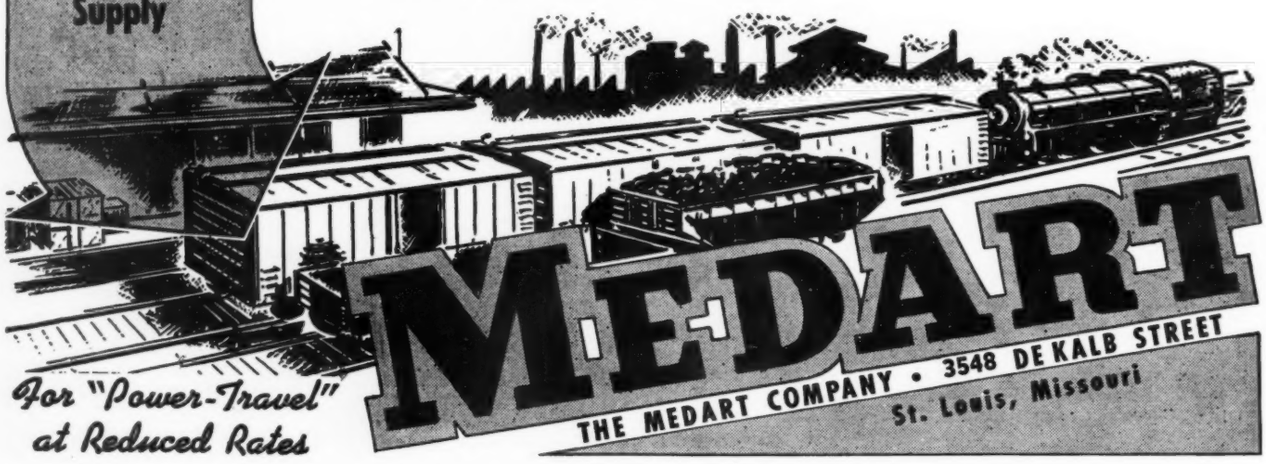
V-Belts are an important factor in efficient power transmission. But a V-Belt, to be correctly made, must also be considered as to its effect on other factors in the drive . . . sheaves, shafts and bearing assemblies.

Medart V-Belts will give you more economical and efficient over-all transmission performance because they have been developed by an organization devoted exclusively to "over-all" Power Transmission efficiency.



For "Power-Travel" at Reduced Rates

M·E·D·A·R·T

THE MEDART COMPANY • 3548 DE KALB STREET
St. Louis, Missouri

GRAVITY OF DRY OIL IN OIL-WATER MIXTURE, DEG. A.P.I.

Gravity of "wet" oil deg. A.P.I.	Percent water in mixture														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
55.0	55.5	56.1	56.8	57.4	58.1	58.8	59.5	60.2	**61.0**	61.7	62.6	63.4	64.2	65.1	**66.0**
.1	.6	.2	.9	.6	.2	.9	.7	.4	.2	.9	.8	.6	.4	.3	.2
.2	.7	.3	**57.0**	.7	.3	**59.0**	.8	.5	.3	**62.0**	.9	.7	.5	.4	.4
.3	.8	.4	.1	.8	.4	.1	.9	.6	.4	.1	**63.0**	.8	.6	.5	.5
.4	.9	.5	.2	.9	.5	.2	**60.0**	.7	.5	.2	.1	.9	.7	.6	.6
55.5	**56.0**	56.6	57.3	**58.0**	58.6	59.3	60.1	60.8	61.6	62.3	63.2	**64.0**	64.8	65.7	66.7
.6	.1	.8	.4	.1	.8	.5	.2	.9	.7	.5	.4	.2	**65.0**	.9	.9
.7	.2	.9	.5	.2	.9	.6	.3	**61.0**	.8	.6	.5	.3	.2	**66.0**	**67.0**
.8	.3	**57.0**	.6	.3	**59.0**	.7	.4	.1	.9	.7	.6	.4	.3	.2	.1
.9	.4	.1	.7	.4	.1	.8	.5	.2	**62.0**	.8	.7	.5	.4	.3	.2
56.0	65.5	57.2	57.8	58.5	59.2	59.9	60.6	61.3	62.1	62.9	63.8	64.6	65.5	66.4	67.3
.1	.6	.3	.9	.6	.3	**60.0**	.8	.5	.3	.1	**64.0**	.8	.7	.6	.5
.2	.7	.4	**58.0**	.7	.4	.1	.9	.6	.4	.2	.1	.9	.8	.7	.7
.3	.8	.5	.1	.8	.5	.2	**61.0**	.7	.5	.3	.2	**65.0**	.9	.8	.8
.4	.9	.6	.2	.9	.6	.3	.1	.8	.6	.4	.3	.1	**66.0**	.9	.9
56.5	**57.0**	57.7	58.3	**59.0**	59.7	60.4	61.2	61.9	62.7	63.5	64.4	65.2	66.1	**67.0**	**68.0**
.6	.1	.8	.5	.2	.9	.6	.3	.1	.9	.7	.6	.4	.3	.2	.2
.7	.2	.9	.6	.3	**60.0**	.7	.4	.2	**63.0**	.8	.7	.5	.4	.3	.3
.8	.3	**58.0**	.7	.4	.1	.8	.5	.3	.1	.9	.8	.6	.5	.4	.4
.9	.4	.1	.8	.5	.2	.9	.6	.4	.2	**64.0**	.9	.7	.6	.6	.5
57.0	57.5	58.2	58.9	59.6	60.3	**61.0**	61.7	62.5	63.3	64.1	**65.0**	65.8	66.7	67.7	68.6
.1	.7	.3	**59.0**	7	.4	.1	.9	.7	.5	.3	.2	**66.0**	.9	.9	.8
.2	.8	.4	.1	.8	.5	.2	**62.0**	.8	.6	.4	.3	.2	67.1	**68.0**	**69.0**
.3	.9	.5	.2	.9	.6	.3	.1	.9	.7	.5	.4	.3	.2	.1	.1
.4	**58.0**	.6	.3	**60.0**	.7	.4	.2	**63.0**	.8	.6	.5	.4	.3	.2	.2
57.5	58.1	58.7	59.4	60.1	60.8	61.5	62.3	63.1	63.9	64.7	65.6	66.5	67.4	68.3	69.3
.6	.2	.8	.5	.2	**61.0**	.7	.5	.3	.1	.9	.8	.7	.6	.5	.5
.7	.3	.9	.6	.3	.1	.8	.6	.4	.2	**65.0**	.9	.8	.7	.7	.7
.8	.4	**59.0**	.7	.4	.2	.9	.7	.5	.3	.1	**66.0**	.9	.8	.8	.8
.9	.5	.1	.8	.5	.3	**62.0**	.8	.6	.4	.2	.1	**67.0**	.9	.9	.9
58.0	58.6	59.2	59.9	60.6	61.4	62.1	62.9	63.7	64.5	65.3	66.2	67.1	**68.0**	**69.0**	**70.0**
.1	.7	.4	.1	.8	.5	.3	.1	.8	.7	.5	.4	.3	.2	.2	.2
.2	.8	.5	.2	.9	.6	.4	.2	.9	.8	.6	.5	.4	.4	.3	.4
.3	.9	.6	.3	**61.0**	.7	.5	.3	**64.0**	.9	.7	.6	.5	.5	.4	.5
.4	**59.0**	.7	.4	.1	.8	.6	.4	.1	**65.0**	.8	.7	.6	.6	.5	.6
58.5	59.1	59.8	60.5	61.2	61.9	62.7	63.5	64.2	65.1	65.9	66.8	67.7	68.7	69.6	70.7
.6	.2	.9	.6	.3	.1	.8	.6	.4	.3	.1	**67.0**	.9	.9	.8	.9
.7	.3	**60.0**	.7	.4	.2	.9	.7	.5	.4	.2	.2	68.1	**69.0**	**70.0**	**71.0**
.8	.4	.1	.8	.5	.3	**63.0**	.8	.6	.5	.3	.3	.2	.1	.1	.1
.9	.5	.2	.9	.6	.4	.1	.9	.7	.6	.4	.4	.3	.2	.2	.2
59.0	59.6	60.3	**61.0**	61.7	62.5	63.2	**64.0**	64.8	65.7	66.5	67.5	68.4	69.3	70.3	71.3
.1	.7	.4	.1	.9	.6	.4	.2	**65.0**	.9	.7	.7	.6	.5	.5	.5
.2	.8	.5	.2	**62.0**	.7	.5	.3	.1	**66.0**	.9	.8	.7	.7	.7	.7
.3	.9	.6	.3	.1	.8	.6	.4	.2	.1	**67.0**	.9	.8	.8	.8	.8
.4	**60.0**	.7	.4	.2	.9	.7	.5	.3	.2	.1	**68.0**	.9	.9	.9	.9
59.5	60.1	60.8	61.5	62.3	**63.0**	63.8	64.6	65.4	66.3	67.2	68.1	**69.0**	**70.0**	**71.0**	**72.0**
.6	.2	.9	.6	.4	.1	.9	.7	.5	.4	.3	.2	.2	.1	.2	.1
.7	.3	**61.0**	.7	.5	.2	**64.0**	.8	.6	.5	.4	.3	.4	.2	.3	.2
.8	.4	.1	.8	.6	.3	.1	.9	.7	.6	.5	.4	.5	.3	.4	.3
.9	.5	.2	.9	.7	.4	.2	**65.0**	.8	.7	.6	.5	.6	.4	.5	.4

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FOR A

LONG, MAINTENANCE-FREE LIFE

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FLAME CLEANING

Since this high pressure pipe is destined for important underground service it is desirable that it give long, trouble-free service. So the specifications state that all flanges and adjacent metal are to be Airco Flame Cleaned, thereby making the pipe's protective paint resist corrosive agents longer. This company is following the example of many other satisfied users who have already solved their pipe and metal painting problems by Airco Flame Cleaning prior to painting. This economical oxyacetylene process removes rust and scale, and dehydrates as it cleans, leaving the metal surface warm and dry and conducive to a long-lasting paint job. It is the best method yet devised to prepare metal for painting.

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AIRCO WILSON

Anything and Everything for GAS WELDING or CUTTING and ARC WELDING

WEIGHT OF DRY MATERIAL ADDED TO DRILLING MUD, LB. PER GAL. (SP. GR. OF ADDITIVE 2.35)

Original fluid, mud or water		Desired mud weight, lb. per gal.																					
Weight, lb. per gal.	Specific gravity	9.0	9.5	10.0	10.5	11.0	11.5	12.0	12.5	13.0	13.5	14.0	14.5	15.0	15.5	16.0	16.5	17.0	17.5	18.0	18.5	19.0	19.5
	1.08	1.14	1.20	1.26	1.32	1.38	1.44	1.50	1.56	1.62	1.68	1.74	1.80	1.86	1.92	1.98	2.04	2.10	2.16	2.22	2.28	2.34	
*8.345	1.00	1.25	2.16	3.42	4.67	6.09	7.69	9.43	11.5	13.9	16.6	19.9	23.8	28.5	34.4	41.9	51.9	65.7	86.7	120	187	359	2,629
9.0	1.08		1.00	2.09	3.25	4.59	6.09	7.76	9.68	11.9	14.5	17.5	21.2	25.6	31.1	38.2	47.6	60.8	79.8	112	172	336	2,470
9.5	1.14			1.00	2.17	3.42	4.84	6.43	8.44	10.3	12.9	15.8	19.3	23.4	28.8	35.5	44.4	56.8	75.4	105	163	320	2,353
10.0	1.20				1.08	2.28	3.67	5.17	6.93	8.93	11.3	14.0	17.4	21.3	26.4	32.8	41.3	53.0	70.8	99.3	154	303	2,236
10.5	1.26					1.17	2.42	3.67	5.51	7.43	9.68	12.3	15.4	19.3	24.0	30.0	38.1	49.2	65.8	93.5	145	286	2,120
11.0	1.32						1.25	2.59	4.17	5.92	8.09	10.5	13.5	17.1	21.6	27.4	35.0	45.5	61.1	86.8	135	270	2,003
11.5	1.38							1.25	2.75	4.51	6.43	8.76	11.6	15.0	19.3	24.6	31.8	41.7	56.4	80.4	127	253	1,886
12.0	1.44								1.42	3.00	4.84	7.01	9.68	12.9	16.8	21.9	28.6	38.0	51.7	74.2	118	235	1,769
12.5	1.50									1.50	3.25	5.26	7.68	10.8	14.4	19.2	25.5	34.2	47.1	68.1	109	218	1,644
13.0	1.56										1.59	3.50	5.78	8.60	12.0	16.4	22.3	30.5	42.4	61.9	99.3	201	1,527
13.5	1.62											1.75	3.84	6.43	9.60	13.7	19.1	26.5	37.6	55.7	90.1	184	1,410
14.0	1.68												1.91	4.26	7.18	10.9	15.9	22.8	33.0	49.7	81.4	168	1,293
14.5	1.74													2.17	4.84	8.18	12.7	18.9	28.2	43.3	72.4	151	1,177
15.0	1.80														2.42	5.51	9.51	15.2	23.5	37.1	63.3	134	1,060
15.5	1.86															2.75	6.34	11.3	18.9	31.0	54.3	118	981
16.0	1.92																3.17	7.59	14.1	24.8	45.2	101	824
16.5	1.98																	3.76	9.43	18.6	36.2	84.3	706
17.0	2.04																		4.67	12.4	27.1	67.3	588
17.5	2.10																			6.18	18.0	53.7	470
18.0	2.16																				9.01	33.5	353
18.5	2.22																					16.8	235
19.0	2.28																						141

Note: The body of this table supplies the weight in lb. of the dry solid to be added per gal. to a drilling fluid of known weight to obtain a mud of higher weight. The above table was calculated with an additive of specific gravity 2.35 (average sp. gr. of bentonitic clay).

To use table find weight of original mud in left hand col. and desired mud weight in top line. Multiply figure from body of table by the vol. of mud in gal. in well or mud pit or times total amount of mud desired when mixing with water.

*Water.

"THIS REEL OF TIGER BRAND SET A NEW RECORD"

A Tiger Brand Wire Line Engineer reports to his boss . . .

Drove out to the McGordon location this morning, talked to the boys awhile and started to look at a big reel of American Tiger Brand they had out there.

The Superintendent drove up about that time and walked over, laid his hand on the reel and said, "Here's the best wire line we've ever had—this reel of Tiger Brand set a new record. Have yet to hear of another line in the field that can touch it in ton-mileage."

You don't have to stop and figure out why this outfit will use only American Tiger Brand Wire Lines!

Bill

YOU can safely turn your wire line problems over to an American Tiger Brand Wire Line Engineer. These men spend their time where lines are being used — they know what punishment they have to take, and what you can do about stretching your wire line dollar. They know wire lines—and they know their job. When you need help, call one of them. You can rest assured that you'll get the most practical recommendations—and in a hurry, too!

American Tiger Brand Wire Lines are made in all constructions and grades, and are quickly available throughout the oil fields. Write us for details, and ask for one of our engineers to call and check over your lines—no obligation at all.

AMERICAN
Tiger Brand
WIRE LINES
Excellay Preformed

LOOK FOR THE TIGER
Buy wire lines from the distributor who displays this sign.

AMERICAN STEEL & WIRE COMPANY
Cleveland, Chicago and New York
COLUMBIA STEEL COMPANY
San Francisco
United States Steel Export Company, New York

UNITED STATES STEEL

RISE IN FLUID LEVEL, ETC., DUE TO RUNNING 3½-IN. NON-UPSET TUBING IN WELL FLUID

Diameter of outer string or open hole, in.	Internal diameter of outer string or open hole, in.	Volume[1] contained in outer string or open hole		Volume[1] contained in annular space		Volume[1] in well bore when tubing is in hole (volume in annulus plus volume in tubing)		For every 100 ft. of tubing run in fluid, fluid level will be raised:	
		gal.	bbl.	gal.	bbl.	gal.	bbl.	in annular space when lower end of tubing is closed, ft.-in.	in well bore when lower end of tubing is open, ft.-in.
Casing strings[2]									
6	5.524	124.5	2.964	68.58	1.633	119.9	2.855	96- 1	12- 0
6	5.240	112.0	2.667	46.08	1.097	97.44	2.320	134- 9	14- 9
6⅝	6.135	153.6	3.657	86.68	2.064	138.0	3.286	76- 1	10- 5
6⅝	5.675	131.4	3.129	55.48	1.321	106.8	2.543	118- 9	13- 6
7	6.538	174.4	4.152	108.5	2.583	159.9	3.807	60- 9	9- 0
7	5.920	143.0	3.405	77.08	1.835	128.4	3.057	85- 6	11- 2
7⅝	7.125	207.1	4.931	141.2	3.362	192.6	4.586	46- 8	7- 6
7⅝	6.625	179.1	4.624	113.2	2.695	164.5	3.917	58- 3	8- 9
8⅝	8.097	267.5	6.369	201.6	4.800	253.0	6.024	32- 8	5- 8
8⅝	7.511	230.2	5.481	164.3	3.912	215.7	5.136	40- 1	6- 8
9⅝	9.063	335.1	7.979	269.2	6.410	320.6	7.633	24- 6	4- 6
9⅝	8.535	297.2	7.076	232.3	5.507	282.7	6.731	23- 4	5- 1
10¾	10.192	423.8	10.09	357.9	8.521	409.3	9.745	18- 5	3- 6
10¾	9.760	388.7	9.255	322.8	7.686	374.2	8.910	20- 5	3-10
11¾	11.150	507.2	12.08	441.3	10.507	492.7	11.731	14-11	2-11
11¾	10.772	473.4	11.27	407.5	9.702	458.9	10.926	16- 2	3- 2
13⅜	12.715	659.6	15.71	593.7	14.136	645.1	15.360	11- 1	2- 3
13⅜	12.347	622.0	14.81	556.1	13.240	607.5	14.464	11- 9	2- 4
Open hole (bit size)[3]									
5⅝	5.625	131.4	3.129	65.48	1.559	116.8	2.781	100- 8	12- 4
6	6.000	146.9	3.498	80.98	1.928	132.3	3.150	81- 5	11- 9
6⅛	6.125	153.1	3.645	87.18	2.076	138.5	3.298	75- 7	11- 4
6½	6.500	172.4	4.105	106.6	2.538	158.0	3.762	61-10	9- 1
6¾	6.750	185.9	4.426	120.0	2.857	171.4	4.081	54-11	8- 5
7	7.000	199.9	4.760	134.0	3.190	185.4	4.414	49- 2	7- 9
7½[4]	7.500	229.5	5.464	163.6	3.895	215.0	5.119	40- 4	6- 8
7¾[4]	7.750	245.1	5.836	179.2	4.267	230.6	5.490	36- 9	6- 3
8½[4]	8.500	294.8	7.019	228.9	5.450	280.3	6.674	28-10	5- 2
9¾[4]	9.750	387.9	9.236	322.0	7.667	373.4	8.890	20- 6	3-10
10⅝	10.625	460.6	10.97	394.7	9.398	446.1	10.621	16- 8	3- 3

The 3½-in. non-upset tubing has a calculated weight of 9.41 lb. per ft. (including a coupling spaced every 20 ft.). The volume displaced by 100 ft. of tubing and 5 couplings: (1) by the steel itself (with lower end of tubing open), 14.379 gal. or 0.3424 bbl.; (2) by the pipe (with lower end of tubing closed), 65.922 gal. or 1.5696 bbl. The volume contained within 100 ft. of the tubing is 51.359 gal. or 1.2228 bbl.

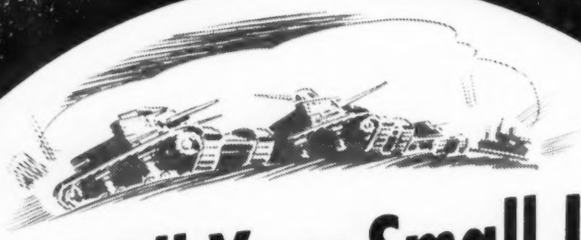
[1]All volume figures are based on 100 ft. of depth; multiply to convert to other depths or lengths. For example, if the depth or length is 5196 ft., multiply by 51.96.

[2]Only maximum and minimum weights of pipe are shown for each casing size.

[3]Variation in diameter of open hole due to caving, etc., is disregarded.

[4]This diameter is an average of the two bit sizes ⅛ in. larger and smaller, respectively.

Table suggested by George B. Rice, Butler & Horne Drilling Co., Dallas, Texas.



Guard All Your Small Lines with a Full "Armored Force" of CHAPMAN 960 Gate Valves

This tough, veteran valve turns back the attacks of wear with a special armor of super-hardened stainless steel on the interchangeable rising stem, seat rings and wedge. This means longer life than you can get from any similar type of small valve for general oil industry service.

So for "total defense" from the usual small-valve troubles on all field and refinery lines up to 2" . . . put Chapman's List 960 in command of the situation. You can get it in sizes from ¼" to 2" . . . for pressures up to 800 lb. at 750° F. . . . and for cold working pressures up to 1500 lb. You can get it, too, in either inside or outside screw models, each with quick-acting, non-sticking threads. Get in touch now with the Chapman plant, or the nearest Chapman office.

THE
CHAPMAN VALVE
MANUFACTURING COMPANY
INDIAN ORCHARD, MASS.

THEORETICAL VOLUME OF GRAVEL REQUIRED AROUND LINERS, IN CU. FT. PER FT. OF LENGTH

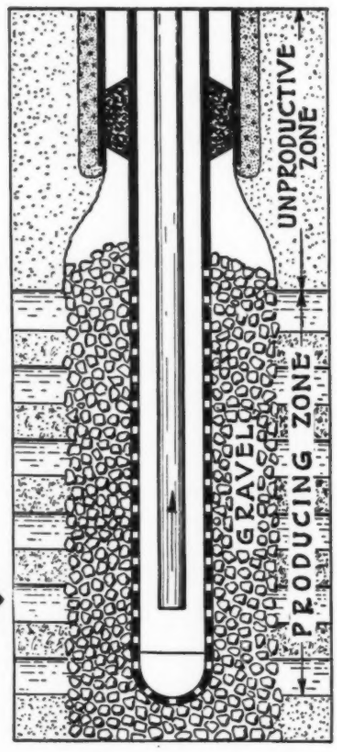
Diameter of hole, in.	Volume of hole without liner, cu. ft. per ft.	Nominal diameter of liner, tubing, casing, etc.													
		1¼	1½	2	2½	3	3½	4	4¾	5½	6	6⅝	7	7⅝	8⅝
		cu. ft./ft. displacement													
		0.015	0.020	0.031	0.045	0.067	0.087	0.111	0.123	0.165	0.196	0.239	0.267	0.317	0.406
6	0.196	0.181	0.176	0.165	0.151	0.128	0.109	0.085	0.073	0.031					
6½	0.230	0.215	0.210	0.189	0.185	0.163	0.143	0.119	0.107	0.065	0.034				
7	0.267	0.252	0.247	0.236	0.222	0.200	0.180	0.156	0.144	0.102	0.071	0.028			
7½	0.307	0.292	0.287	0.276	0.262	0.240	0.220	0.196	0.184	0.142	0.111	0.068	0.040		
8	0.349	0.334	0.329	0.318	0.304	0.282	0.262	0.238	0.226	0.184	0.153	0.110	0.082	0.032	
8½	0.394	0.379	0.374	0.363	0.349	0.327	0.307	0.283	0.271	0.229	0.198	0.155	0.127	0.077	
9	0.442	0.427	0.422	0.411	0.397	0.375	0.355	0.331	0.319	0.277	0.246	0.203	0.175	0.125	0.036
9½	0.492	0.477	0.472	0.461	0.447	0.425	0.405	0.381	0.379	0.327	0.296	0.253	0.225	0.175	0.086
10	0.546	0.531	0.526	0.515	0.501	0.479	0.459	0.435	0.423	0.381	0.350	0.307	0.279	0.229	0.140
10½	0.602	0.587	0.582	0.571	0.557	0.535	0.515	0.491	0.479	0.437	0.406	0.363	0.335	0.285	0.196
11	0.660	0.645	0.640	0.629	0.615	0.593	0.573	0.550	0.537	0.495	0.464	0.421	0.393	0.343	0.254
11½	0.721	0.706	0.701	0.690	0.676	0.654	0.634	0.610	0.598	0.556	0.525	0.482	0.454	0.404	0.315
12	0.785	0.770	0.765	0.754	0.740	0.718	0.698	0.674	0.662	0.620	0.589	0.546	0.518	0.468	0.379
12½	0.852	0.837	0.832	0.821	0.807	0.795	0.765	0.741	0.729	0.687	0.656	0.613	0.585	0.535	0.446
13	0.922	0.907	0.902	0.891	0.877	0.855	0.835	0.811	0.799	0.757	0.726	0.683	0.655	0.605	0.516
13½	0.994	0.979	0.974	0.963	0.949	0.927	0.907	0.883	0.871	0.829	0.798	0.755	0.727	0.677	0.588
14	1.069	1.054	1.049	1.038	1.024	1.002	0.982	0.958	0.946	0.904	0.873	0.830	0.802	0.752	0.663
14½	1.147	1.132	1.127	1.116	1.102	1.080	1.060	1.036	1.024	0.982	0.951	0.909	0.880	0.730	0.741
15	1.227	1.212	1.207	1.196	1.182	1.160	1.140	1.116	1.104	1.062	1.031	1.988	0.960	0.910	0.821
15½	1.310	1.295	1.290	1.279	1.265	1.243	1.223	1.199	1.187	1.145	1.114	1.071	1.043	1.993	0.904
16	1.396	1.381	1.376	1.365	1.351	1.329	1.309	1.285	1.273	1.231	1.200	1.157	1.129	1.979	0.990
16½	1.485	1.475	1.465	1.454	1.440	1.418	1.398	1.374	1.362	1.320	1.289	1.246	1.218	1.168	1.079
17	1.576	1.561	1.556	1.545	1.531	1.509	1.467	1.491	1.453	1.411	1.380	1.337	1.309	1.259	1.170
17½	1.670	1.655	1.650	1.639	1.625	1.603	1.593	1.559	1.547	1.505	1.474	1.431	1.403	1.353	1.264
18	1.767	1.752	1.747	1.736	1.722	1.700	1.680	1.656	1.644	1.602	1.571	1.528	1.500	1.450	1.361
18½	1.867	1.852	1.847	1.836	1.822	1.800	1.780	1.756	1.744	1.702	1.671	1.628	1.600	1.550	1.461
19	1.969	1.954	1.949	1.938	1.924	1.902	1.882	1.859	1.846	1.804	1.773	1.730	1.702	1.652	1.563
19½	2.074	2.059	2.054	2.043	2.029	1.007	1.997	1.963	1.951	1.909	1.868	1.835	1.807	1.757	1.668
20	2.182	2.167	2.162	2.151	2.137	1.115	2.095	2.071	2.059	2.017	1.986	1.943	1.915	1.865	1.776
20½	2.229	2.214	2.209	2.198	2.184	2.162	2.142	2.108	2.106	2.064	2.033	1.990	1.962	2.912	1.823
21	2.405	2.390	2.385	2.374	2.360	2.338	2.318	2.294	2.282	2.240	2.209	2.166	2.138	2.088	1.999
21½	2.521	2.506	2.501	2.490	2.476	2.454	2.434	2.410	2.398	2.356	2.325	2.282	2.254	2.204	2.115
22	2.640	2.625	2.620	2.609	2.595	2.573	2.533	2.529	2.517	2.475	2.444	2.401	2.373	2.343	2.234
22½	2.761	2.746	2.741	2.730	2.716	2.694	2.674	2.650	2.638	2.596	2.565	2.522	2.494	2.444	2.355
23	2.885	2.870	2.865	2.854	2.840	2.818	2.798	2.774	2.762	2.720	2.689	2.646	2.618	2.568	2.479
23½	3.012	2.997	2.992	2.981	2.967	2.945	2.925	2.901	2.889	2.847	2.816	2.773	2.745	2.695	2.606
24	3.142	3.127	3.122	3.111	3.097	3.075	3.055	3.031	3.019	2.977	2.946	2.903	2.875	2.825	2.736
24½	3.274	3.259	3.254	3.243	3.229	3.207	3.187	3.163	3.151	3.109	3.078	3.035	3.007	2.957	2.868
25	3.409	3.394	3.389	3.378	3.364	3.342	3.322	3.298	3.286	3.244	3.213	3.170	3.142	3.092	3.003
25½	3.546	3.531	3.526	3.515	3.501	3.479	3.459	3.435	3.423	3.381	3.350	3.307	3.279	3.229	3.140
26	3.687	3.672	3.667	3.655	3.642	3.620	3.600	3.576	3.564	3.522	3.491	3.448	3.420	3.370	3.281
26½	3.830	3.815	3.810	3.799	3.785	3.763	3.743	3.719	3.707	3.665	3.634	3.591	3.563	3.513	3.424
27	3.976	3.961	3.956	3.945	3.931	3.909	3.889	3.865	3.853	3.811	3.780	3.737	3.709	3.659	3.560
27½	4.124	4.109	4.104	4.093	4.079	4.057	4.037	4.013	4.001	3.959	3.928	3.885	3.857	3.807	3.718
28	4.276	4.261	4.256	4.245	4.231	4.209	4.189	4.165	4.153	4.111	4.080	4.037	4.009	3.959	3.870
28½	4.430	4.415	4.410	4.399	4.395	4.363	4.343	4.319	4.307	4.265	4.334	4.191	4.163	4.113	4.024
29	4.587	4.572	4.567	4.556	4.542	4.520	4.500	4.476	4.464	4.422	4.391	4.348	4.320	4.270	4.181
29½	4.816	4.801	4.796	4.785	4.771	4.749	4.729	4.705	4.693	4.651	4.620	4.577	4.549	4.499	4.400
30	4.908	4.893	4.888	4.877	4.863	4.841	4.821	4.787	4.785	4.743	4.712	4.769	4.641	4.691	4.502
31	5.241	5.226	5.221	5.210	5.196	5.174	5.154	5.130	5.118	5.076	5.045	5.002	4.974	4.924	4.835
32	5.585	5.570	5.565	5.554	5.540	5.518	5.498	5.474	5.462	5.420	5.389	5.346	5.138	5.268	5.179
33	5.939	5.924	5.919	5.908	5.894	5.872	5.852	5.828	5.816	5.774	5.743	5.700	5.672	5.622	5.533
34	6.305	6.290	6.285	6.274	6.260	6.238	6.218	6.194	6.182	6.140	6.109	6.066	6.038	5.998	5.899
35	6.681	6.666	6.661	6.650	6.636	6.614	6.594	6.570	6.558	6.516	6.485	6.442	6.414	6.364	6.275
36	7.067	7.052	7.047	7.036	7.022	7.000	6.980	6.956	6.944	6.902	6.871	6.828	6.800	6.750	6.661

Note: Variation in hole size due to sloughing or washing is disregarded.

Example: Eight and five-eighths-in. hole has been reamed to 15 in. diameter for a distance of 10 ft. The 7⅝-in. liner is set 2 ft. off bottom. How much gravel will be required for packing?

Ans. In the column headed "Volume of hole without liner" opposite 15 find 1.227, volume of 1 ft. of 15-in. hole. $2 \times 1.227 = 2.454$ cu. ft. volume of reamed hole without liner. Opposite 15 in the column headed 7⅝ find .910, cu. ft. of gravel per 1 ft. of liner. $8 \times .910 = 7.280$ cu. ft. of gravel required around liner. Add 2.454 to 7.280 equals 9.734 cu. ft. total gravel required.

Protect your wells by Gravel Packing here →



OIL PRODUCTION from unconsolidated and fine sands presents certain difficulties, including sand cutting of screens or perforated liners, the sanding up of flowing wells, and inordinate wear on pumping equipment due to the abrasive action of the sand carried by the oil.

Producers who face this problem will find that gravel packing by circulation offers protection with many practical advantages.

Only by this method can the thickness and character of the gravel pack be varied to match the character of the sand and oil encountered. The gravel pack, through its contact with the sand, holds it in place and prevents its movement.

No lower cost method as fully effective has as yet been devised. The need for expensive screens and liners is eliminated. If ever necessary, the ordinary perforated liner used in this method could readily and easily be extracted and replaced.

TEXACO DEVELOPMENT CORPORATION

A Subsidiary of The Texas Company

26 Journal Square • Jersey City, N. J.

SQUARE ROOTS OF WHOLE NUMBERS

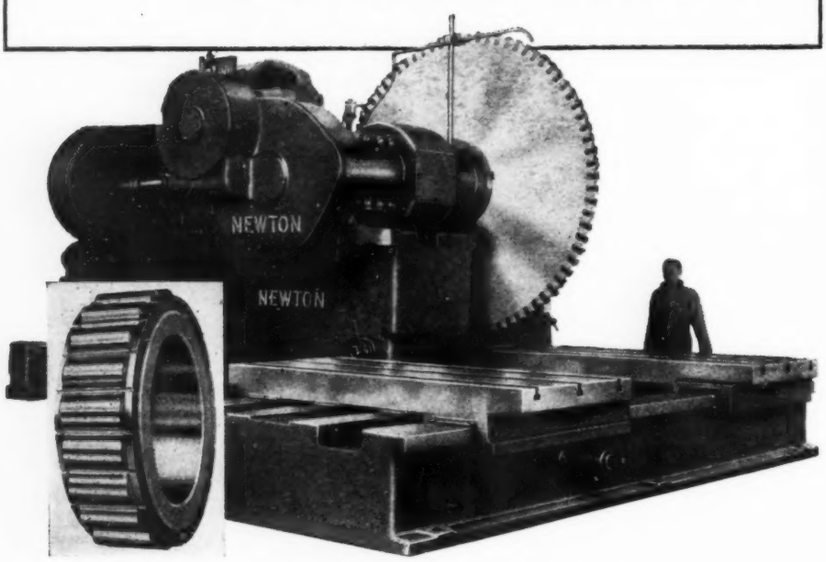
	0	1	2	3	4	5	6	7	8	9
..	.....	1.000	1.414	1.732	2.000	2.236	2.449	2.646	2.828	3.000
10	3.162	3.317	3.464	3.606	3.742	3.873	4.000	4.123	4.243	4 359
20	4.472	4.583	4.690	4.796	4.899	5.000	5.099	5.196	5.292	5.385
30	5.477	5.568	5.657	5.745	5.831	5.916	6.000	6.083	6.164	6.245
40	6.325	6.403	6.481	6.557	6.633	6.708	6.782	6.856	6.928	7.000
50	7.071	7.141	7.211	7.280	7.348	7.416	7.483	7.550	7.616	7.681
60	7.746	7.810	7.874	7.937	8.000	8.062	8.124	8.185	8.246	8.307
70	8.367	8.426	8.485	8.544	8.602	8.660	8.718	8.775	8.832	8.888
80	8.944	9.000	9.055	9.110	9.165	9.220	9.274	9.327	9.381	9.434
90	9.487	9.539	9.592	9.644	9.695	9.747	9.798	9.849	9.899	9.950
100	10.000	10.050	10.100	10.149	10.198	10.247	10.296	10.344	10.392	10.440
110	10.448	10.535	10.583	10.630	10.677	10.724	10.770	10.817	10.863	10.909
120	10.954	11.000	11.045	11.091	11.136	11.180	11.225	11.269	11.314	11.358
130	11.402	11.446	11.489	11.533	11.576	11.619	11.662	11.705	11.747	11.790
140	11.832	11.874	11.916	11.958	12.000	12.042	12.083	12.124	12.166	12.207
150	12.247	12.288	12.329	12.369	12.410	12.450	12.490	12.530	12.570	12.610
160	12.649	12.689	12.728	12.767	12.806	12.845	12.884	12.923	12.961	13.000
170	13.038	13.077	13.115	12.153	13.191	13.229	13.267	13.304	13.342	13.379
180	13.416	13.454	13.491	13.528	13.565	13.601	13.638	13.675	13.711	13.748
190	13.784	13.820	13.856	13.892	13.928	13.964	14.000	14.036	14.071	14.107
200	14.142	14.177	14.213	14.248	14.283	14.318	14.353	14.387	14.422	14.457
210	14.491	14.526	14.560	14.595	14.629	14.663	14.697	14.731	14.765	14.799
220	14.832	14.866	14.900	14.933	14.967	15.000	15.033	15.067	15.100	15.133
230	15.166	15.199	15.232	15.264	15.297	15.330	15.362	15.395	15.427	15.460
240	15.492	15.524	15.556	15.588	15.621	15.652	15.684	15.716	15.748	15.780
250	15.811	15.843	15.875	15.906	15.937	15.696	16.000	16.031	16.062	16.094
260	16.125	16.156	16.186	16.217	16.248	16.279	16.310	16.340	16.371	16.401
270	16.432	16.462	16.492	16.523	16.553	16.583	16.613	16.643	16.673	16.703
280	16.733	16.763	16.793	16.823	16.852	16.882	16.912	16.941	16.971	17.000
290	17.029	17.059	17.088	17.117	17.146	17.176	17.205	17.234	17.263	17.292
300	17.321	17.349	17.378	17.407	17.436	17.464	17.493	17.521	17.550	17.578
310	17.607	17.635	17.664	17.692	17.720	17.748	17.776	17.805	17.833	17.861
320	17.889	17.917	17.944	17.972	18.000	18.028	18.056	18.083	18.111	18.138
330	18.166	18.193	18.221	18.248	18.276	18.303	18.330	18.358	18.385	18.412
340	18.439	18.466	18.493	18.520	18.547	18.574	18.601	18.628	18.655	18.682
350	18.708	18.735	18.762	18.788	18.815	18.841	18.868	18.894	18.921	18.947
360	18.974	19.000	19.026	19.053	19.079	19.105	19.131	19.157	19.183	19.209
370	19.235	19.261	19.287	19.313	19.339	19.365	19.391	19.417	19.442	19.468
380	19.494	19.519	19.545	19.570	19.596	19.621	19.647	19.623	19.698	19.723
390	19.748	19.774	19.799	19.824	19.849	19.875	19.00	19.925	19.950	19.975
400	20.000	20.025	20.050	20.075	20.100	20.125	20.149	20.174	20.199	20.224
410	20.249	20.273	20.298	20.322	20.347	20.372	20.396	20.421	20.445	20.470
420	20.494	20.518	20.543	20.567	20.591	20.616	20.640	20.664	20.688	20.712
430	20.736	20.761	20.785	20.809	20.833	20.857	20.881	20.905	20.928	20.952
440	20.976	21.000	21.024	21.048	21.071	21.095	21.119	21.142	21.166	21.190
450	21.213	21.237	21.260	21.284	21.307	21.331	21.354	21.378	21.401	21.424
460	21.448	21.471	21.494	21.517	21.541	21.564	21.587	21.610	21.633	21.656
470	21.680	21.703	21.726	21.749	21.772	21.795	21.817	21.840	21.863	21.886
480	21.909	21.932	21.955	21.977	22.000	22.023	22.045	22.068	22.091	22.113
490	22.136	22.159	22.181	22.204	22.226	22.249	22.271	22.294	22.316	22.338

Example: What is the square root of 386?

Solution: On the line opposite 380 and under the column headed 6, the answer is found to be 19.647.

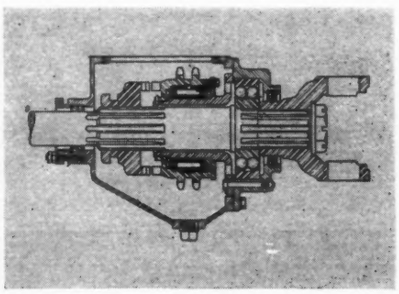
IN THE NEWS

WITH BANTAM BEARINGS



TEN-FOOT CIRCULAR BLADE is a striking feature of this Newton Cold Saw Cutting-off Machine manufactured by Consolidated Machine Tool Corporation—probably the largest machine of its type ever built. Bantam Radial Roller Bearings were selected by Consolidated for use in this giant machine because of their compactness and high load capacity. Here is a typical instance of Bantam's skill in meeting novel design requirements.

BANTAM SUPPLIES ANTI-FRICTION BEARINGS of many sizes and types to meet the requirements of Industry and Government for defense production. Because of Bantam's broad experience in the design and application of every major type of anti-friction bearing, Bantam engineers are exceptionally well qualified to undertake the solution of new and difficult bearing problems. For advice on anti-friction bearings, TURN TO BANTAM.

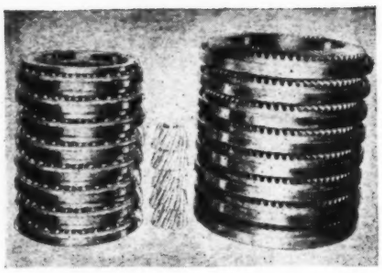


THIS COMPACT POWER TAKE-OFF is designed to take full advantage of the compact, space-saving features and high-capacity of Bantam's Quill Bearing. Built by Sterling Motors Corp. for use on heavy-duty Sterling trucks, it illustrates another application for this low cost anti-friction bearing. Completely self-contained, the Quill Bearing is admirably adapted to production-line assembly methods. For details on this unusual bearing, write for Bulletin P-104.

BANTAM BEARINGS

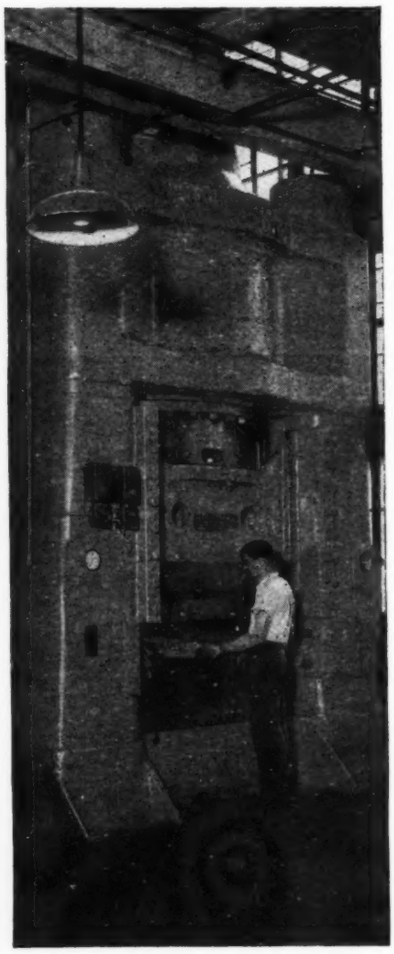
STRAIGHT ROLLER · TAPERED ROLLER · NEEDLE · BALL

BANTAM BEARINGS CORPORATION • SOUTH BEND • INDIANA



FOR HEAVY-DUTY WELL DRILLING, Pennington Signaling Core Barrel's 12¾" oil-bath rotary offers outstanding advantages in capacity and economy. Photo shows Bantam Ball Thrust Bearings and drive gears which give this rotary a capacity of 70 tons at 100 RPM, permit it to be operated continuously at 600 RPM when drilling. "Bantam Bearings are precision-made," says Mr. Harry Pennington, "and we could ask for nothing better than what you furnish. Our products are also precision-made to take advantage of Bantam's accuracy."

4000-TON FORMING PRESS built by Baldwin-Southwark is powered by two Oilgear Two-way Variable Displacement Pumps with a combined displacement of 143 gallons of oil per minute at pressures up to 3,000 pounds per square inch. Each pump rotor turns on large Bantam Radial Roller Bearings—7.0866" I.D. for front rotor bearings, 9.0551" I.D. for rear rotor bearings.



Suppliers of Materials and Equipment to the Petroleum Industry Assigned A-8 Preference Rating by OPM

SUPPLY houses furnishing materials and equipment to the petroleum industry are assigned a Preference Rating of A-8 on their orders of specified quantities of materials by Preference Rating Order No. P-83 issued December 8, 1941, by the Priorities Division.

This order has the effect of classifying materials needs of the petroleum industry as defense requirements, inasmuch as orders for materials to be used in the production, refining, transportation, or marketing of petroleum are given a defense rating. Production, as defined in the order, includes discovery, development, and depletion of petroleum pools. Marketing covers the operation of facilities for the distribution of petroleum products, not including natural gas, to service stations or to consumers, including service stations, substations, bulk plants, warehouses, and wholesale depots.

Preference Rating Order No. P-83 gives priority assistance in supplying needs of the entire petroleum industry for materials and equipment, because the industry is so organized that the supply houses can be called upon to provide a perpetual inventory of the materials needs of the industry.

The order covers supply houses as that term is generally accepted in the industry, and may also cover tool or equipment manufacturers exclusively engaged in supplying materials to the petroleum industry. Before being entitled to use of a preference rating under the order, a supply house or manufacturer must execute an acceptance of the terms of the order and must also provide information as to previous shipments, inventories, and requirements of the materials for which a preference rating is assigned. A special form, PD-82(a), has been prepared for this purpose.

No supply house may make deliveries of materials obtained by application of the preference rating assigned to it except under purchase orders or contracts which themselves bear a preference rating. Supplemental orders will be issued by the Priorities Division granting a general rating to specified orders for the materials sold through supply houses, so that deliveries of materials will not be held up pending submission of individual applications for priority assistance by each firm in the petroleum industry.

Manufacturers delivering materials to the supply houses will be given an opportunity to obtain a rating covering their needs for materials over a three-month period under the recently announced Production Requirements Plan.

The order covers materials to be used in the discovery and development of new oil wells, in addition to materials for maintenance and operation, thus providing for continuous development of the nation's petroleum resources. Such continuous development is necessary to avoid a drain on existing wells, which would reduce their natural pressure and might require installation of pumping equipment. It is believed that in the long run continuous development of new wells will require a smaller quantity of strategic materials for production equipment than would a more intensive production from existing wells.

All communications referring to this order should be addressed to the Petroleum Coördinator, Washington, D. C.

OFFICE OF PRODUCTION MANAGEMENT
Priorities Division
PREFERENCE RATING ORDER NO. P-83
Material Stocked by Supply Houses for Distribution to the Petroleum Industry

To: (name of supply house):_____

*Address*_____ *Serial No.*_____

PREFERENCE RATING ORDER. For the purpose of facilitating the acquisition of Material to be held for distribution to Persons engaged in the Production, Transportation, Refining, and Marketing of Petroleum, a preference rating is hereby assigned to deliveries to the above-named Supply House and to deliveries to its Suppliers, upon the following terms:

(a) DEFINITIONS.

(1) "Supply House" means the specific person to whom this Order is addressed above.

(2) "Petroleum" means petroleum, petroleum products, and associated hydrocarbons including but not limited to natural gas.

(3) "Production" means the discovery, development, and depletion of petroleum pools, including without limitation the operation of cycling plants and plants for the extraction of natural gasoline and associated hydrocarbons.

(4) "Refining" means the operation of a plant or plants, other than those specified in subparagraph (3), for the production of finished or unfinished petroleum products (including but not limited to hydrocarbon oils or gases).

(5) "Transportation" means the operation of all petroleum terminal and terminal storage facilities and the operation of all pipe lines and gathering systems for the transportation of petroleum from facilities where petroleum is first gauged to any refining or local distribution facility and from any refining facility to any marketing or local distribution facility, except that in no case shall transportation include distribution of natural gas by means of local distribution facilities.

(6) "Marketing" means the operation of all facilities, other than those specified in subparagraph (5), for the distribution of petroleum products (not including natural gas) to service stations or to consumers, including without limitation service stations, substations, bulk plants, warehouses, and wholesale depots.

(7) "Sub-Supplier" means any person with whom a contract or purchase order has been placed for delivery:

(i) To a Supply House, of Material which has been specifically authorized for rating on Form PD-82(a).

(ii) To another Sub-Supplier, of Material which will be physically or chemically incorporated into Material to be delivered to a Supply House under a rating authorized pursuant to this Order.

(8) "Material" means any commodity, equipment, accessories, parts, assemblies or products of any kind.

(b) ASSIGNMENT OF PREFERENCE RATING. Preference Rating A-8 is hereby assigned:

(1) to deliveries to the Supply House of those quantities of Material which may be specifically authorized for rating on Form PD-82(a) by the Director of Priorities, and

(2) to deliveries to any Sub-Supplier, of Material which will be physically or chemically incorporated into Material to be delivered to the Supply House under a rating authorized pursuant to this Order.

(c) PERSONS ENTITLED TO APPLY PREFERENCE RATINGS. The Preference Rating hereby assigned may be applied, in the manner and to the extent hereby authorized by:

(*Continued on Page 122*)

(1) the Supply House, and

(2) any Sub-Supplier who has been furnished with a signed copy of this order in the manner specified in paragraph (e).

(d) RESTRICTIONS ON USE OF RATING.

(1) *Restrictions on Supply House.* The Supply House may apply the preference rating only to those quantities and kinds of Material specifically authorized for rating by the Director of Priorities on Form PD-82 (a).

(2) *Restrictions on Sub-Supplier.* No Sub-Supplier may apply said rating:

(i) unless the Material to be delivered to him is itself required to enable him to make a rated delivery to the Supply House or to another Sub-Supplier; *provided*, that no delivery of Material to such Sub-Supplier shall be deemed to be required unless the Sub-Supplier cannot make his rated deliveries and still retain a minimum practicable working inventory;

(ii) to obtain deliveries greater in quantity or on dates earlier than required for the delivery on schedule of the Material rated under this Order;

(iii) to obtain deliveries of Material which will not be physically or chemically incorporated into Material the delivery of which to the Supply House has been authorized for rating on Form PD-82 (a).

(e) APPLICATION OF PREFERENCE RATING. The Supply House or any Sub-Supplier in order to apply the Preference Rating to deliveries to him must:

(1) sign the Acceptance at the end of a copy of this Order, detach it and file such signed Acceptance with the Director of Priorities; *provided*, that after one such Acceptance of Preference Rating Order No. P-83 shall have been duly filed as herein provided, no additional Acceptance need be filed for subsequent applications of said Order, whether such subsequent applications shall be of an Order bearing the same or different Serial Number from the Order accepted; and

(2) furnish one copy of Preference Rating Order No. P-83, together with an unsigned form of acceptance thereof, to each of his Sub-Suppliers with whom he has placed a contract or purchase order for material to the delivery of which he elects to apply the preference rating hereby assigned. After one such copy of said Order, regardless of Serial Number, has been furnished to a particular Sub-Supplier, no additional copy of said Order need be furnished to that Sub-Supplier to cover any subsequent applications of the preference rating hereby assigned.

(3) The Supply House and each Sub-Supplier, in order to apply the Preference Rating hereby assigned to deliveries to him, must endorse the following statement on the original and on all copies of each Purchase Order or Contract for Materials authorized for rating on Form PD-82 (a), or to be physically or chemically incorporated into such material:

"Preference Rating A-8. Purchase Order for material pursuant to Preference Rating Order No. P-83, Serial No. ....., with which I am familiar."

The endorsement shall be manually signed by an authorized official of the Supply House or Sub-Supplier and the original, or a copy of the Purchase Order shall be delivered to the seller of such material. Such endorsement shall constitute a certification to the Office of Production Management that the Supply House or Sub-Supplier is entitled to apply the rating to such delivery pursuant to this Order. Such Purchase Order or Contract shall not include any material, the delivery of which is not rated pursuant to this Order.

(4) A Sub-Supplier who has been furnished with a copy of Preference Rating Order No. P-83, by two or more Supply Houses, or Sub-Suppliers, and who has received from such Supply House or Sub-Suppliers, endorsed Purchase Orders or Contracts for material rated pursuant to this Order, may include in a single Purchase Order or Contract, any part, or all, of the material which he requires to make his rated deliveries to such Supply Houses or Sub-Suppliers, but must specify in the endorsement on such single Purchase Order, all of the serial numbers contained in the Purchase Orders which have been so received by him and to fill which he is applying the Preference Rating.

(5) The Preference Rating hereby assigned may be applied only to written purchase orders or contracts.

(f) RESTRICTIONS ON DELIVERIES BY SUPPLY HOUSES. No Supply House may make deliveries of material obtained by application of the Preference Rating hereby assigned except under Purchase Orders or Contracts bearing a preference rating assigned by the Director of Priorities.

(g) RECORDS. In addition to the records required to be kept under Priorities Regulation No. 1, the Supply House, and each Sub-Supplier placing or receiving any purchase order or contract rated hereunder, shall each retain, for a period of two years, for inspection by representatives of the Office of Production Management, endorsed copies of all such Purchase Orders or Contracts, whether accepted or rejected, segregated from all other Purchase Orders or Contracts, or filed in such manner that they can be readily segregated for such inspection.

(h) COMMUNICATIONS TO OFFICE OF PETROLEUM CO-ORDINATOR. Acceptances of this Order, all reports required to be filed hereunder, and all communications concerning this Order, shall, unless otherwise directed, be addressed to:

"Office of Petroleum Co-ordinator, Washington, D.C. Ref.: P-83"

(i) VIOLATIONS. Any Person who willfully violates any provision of this Order or who by any act or omission falsifies records to be kept or information to be furnished pursuant to this Order may be prohibited from receiving further deliveries of any Material subject to allocation, and such further action may be taken as is deemed appropriate, including a recommendation for prosecution under Section 35 (A) of the Criminal Code (18 U.S.C. 80).

(j) REVOCATION OR AMENDMENT. This Order may be revoked or amended at any time as to the Supply House or any Sub-Supplier. In the event of revocation, deliveries already rated pursuant to this Order shall be completed in accordance with said rating, unless the rating has been specifically revoked with respect thereto. No additional applications of the rating to other deliveries shall thereafter be made by the Supply House or Sub-Supplier affected by such revocation.

(k) APPLICABILITY OF PRIORITIES REGULATION NO. 1. This Order and all transactions affected thereby are subject to the provisions of Priorities Regulation No. 1, as amended from time to time, except to the extent that any provisions hereof may be inconsistent therewith, in which case the provisions of this Order shall govern.

(l) EFFECTIVE DATE. This Order shall take effect on the date specified in the heading hereof, and shall continue in effect until revoked.

(P. D. Reg. 1, Aug. 27, 1941, 6 F. R. 4489; O. P. M. Reg. 3 Amended, Sept. 2, 1941, 6 F. R. 4865; E. O. 8629, Jan. 7, 1941, 6 F. R. 191; E. O. 8875, Aug. 28, 1941, 6 F. R. 4483; sec. 2 (a), Public No. 671, 76th Congress, Third Session, as amended by Public No. 89, 77th Congress, First Session; sec. 9, Public No. 783, 76th Congress, Third Session.)

Issued this 8th day of December, 1941.

ACCEPTANCE OF PREFERENCE RATING ORDER NO. P-83

To (name of supply house):_____

*Address*_____

*Serial No.*_____ *Date*_____

To be detached from the foregoing Order, signed by an authorized official of the Supply House or Sub-Supplier, and returned to the Office of Petroleum Coördinator, Washington, D. C., before the Supply House or Sub-Supplier applies the preference rating assigned by the foregoing Order.

The Supply House or Sub-Supplier should execute only the Acceptance which he returned to the Office of Petroleum Coördinator. He should not execute the Acceptance attached to the copies of the Order which he furnishes to other persons when he first applies the preference rating.

[Before signing this Acceptance, read carefully Section (c), (d), (e), and (f) of the foregoing Order.]

The Supply House or Sub-Supplier named below hereby accepts Preference Rating Order No. P-83 and certifies to the Director of Priorities of the Office of Production Management that he is entitled to apply the preference rating assigned in said Order in accordance with its terms.

Dated this_____ day of_____, 194__.

_____

Legal Name of Supply House or Sub-Supplier

*By*_____

Name and Title of Authorized Individual

[Section 35 (a) of the Criminal Code, 18 U.S.C. 80, makes it a criminal offense to make a false statement of representation to any Department or Agency of the United States as to any matter within its jurisdiction.]

The Supply House may obtain additional copies of Preference Rating Order No. P-83 from the Office of Petroleum Coördinator, Washington D. C. Sub-Suppliers may not obtain such copies from the Office of Petroleum Coördinator, but should procure them from the Supply House. This Order cannot be reproduced by either the Supply House or the Sub-Supplier.

Use of Dynamite Saves Time and Money in Refinery Construction

by R. G. Lovell

Development Engineer, Hancock Oil Company of California

PETROLEUM ENGINEER Exclusive Feature

THERE has always been a considerable amount of prejudice against blasting in and around an operating refinery. The writer has not had this prejudice because of several years of previous mining experience involving daily use of explosives. In recent years, it has been possible on several occasions to expedite difficult jobs of demolition and excavation by employing this experience.

As a part of the work involved in the recent installation of a new tube heater, it was necessary to remove two blocks of reinforced concrete, each 11 ft. by 24 ft. by 5 ft. and, therefore, containing about 50 cu. yards each. In addition, one smaller tower foundation of about 7 yards was scheduled for removal.

To remove these foundations in the conventional manner, by employing jackhammers and hand labor, was conservatively estimated to cost $1200. This figure may seem excessive to some but it must be remembered that the blocks were 5 ft. thick, which would necessitate simply spalling off the concrete in rather small pieces. Further, each piece would have to be removed by hand as it was broken off by the hammer so that the hammer operator would have a new surface upon which to continue drilling. Elapsed time to finish the job was estimated to be 12 days. This time could not be allotted and the estimated cost was distressingly high.

In order to conserve both time and money it was decided to blast the concrete. It was stipulated that there was to be no shutdown of the plant for the blasting operation. A man of extensive experience in this class of work was requisitioned from one of the leading powder companies. This man visited the job and laid out 24 holes in each of the large blocks and directed that they be drilled to a depth of 3 ft. The actual drilling was accomplished with two jackhammers and a total of 24 man-hours at a cost of $28.00. Laborers to make excavations and prepare safety measures totaled 10 man-hours or $7.50.

Drilling shot holes in preparation for blasting

The powder man required only 2½ hours to load the holes with 30 lb. of 40 percent dynamite. After loading the holes the foundations were covered with 3-in. planks, then a layer of tank plate and, finally, 8 by 8 timbers. Much anxiety was evidenced by stillmen on duty and others over the possible disastrous results of the blasts. This anxiety, however, was unwarranted for, on the first shot—one complete foundation—the covering hardly raised. The second, which had not been cleared so completely from surrounding earth, raised about 3 ft. None of the rock flew into the air.

Upon removing the covering, the concrete was found to be broken up completely and uniformly into pieces, the larger of which were about 2 ft. by 3 ft. by 2 ft., all of which were easily handled by a clamshell.

The total cost of the preparation and blasting was $75.00 with about an equal amount for removing the rubble and loading it into trucks with the clamshell crane. The comparison between this sum and the cost of doing the job by hand is too obvious to require emphasis.

One of the lessons learned from the condition of the rubble was that used sucker rod does not make a proper reinforcing steel for concrete. These foundations had been installed more than seven years ago and some of the heavier pieces slid off the rod as the clamshell took hold of the adjacent piece. This is ample proof that an insufficient bond existed between the steel and the concrete.

☆☆☆

General appearance of the demolished blocks after the blasts

HAD A HEAD START ON THE LAST QUARTER-CENTURY

The oil and gas industry grew to full maturity in the last 25 years. Yet, it was the *previous* quarter-century that made the last one so successful.

Pioneers—like Spang & Company—had a head start on the Machine Age. Their efforts, based on years of hard-won knowledge, resulted in a ready supply of fuel and lubricants when the automobile, the machine tool and the airplane came along.

Today—with ever greater demands being placed on the industry—Spang Cable Tools are playing their part. And playing it well, because over 50 years of experience have made these "High Standard" Cable Tools completely efficient, strictly reliable, truly economical.

SPANG & COMPANY, Butler, Pa.

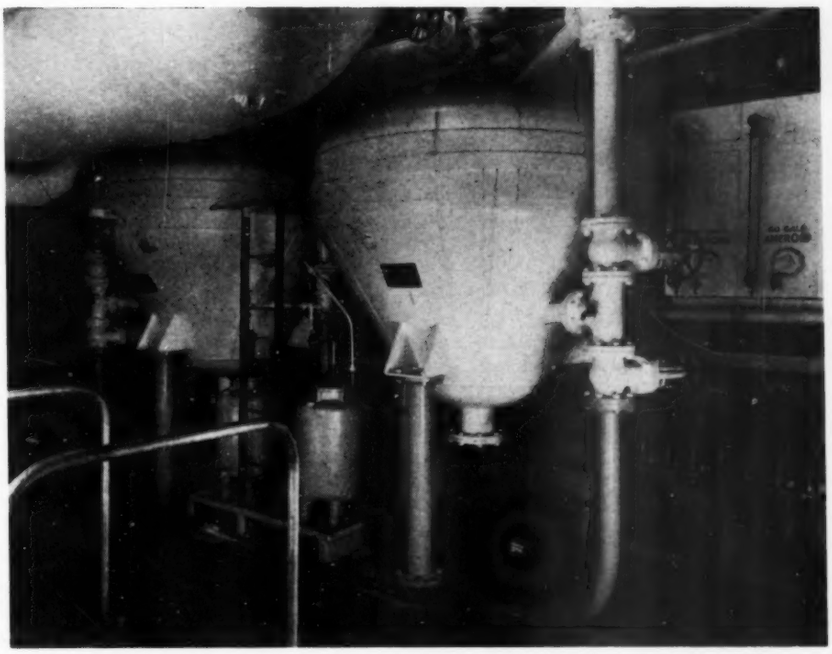
Filters are Used to Remove Oil From Boiler Water

CONDENSED exhaust steam from reciprocating engines and pumps is frequently wasted because it is contaminated by oil or grease. Oily condensate, if used for boiler feeding, is frequently the cause of serious operating troubles, including: (1) foaming and priming; (2) overheating of boiler tubes, and (3) corrosion.

That oil contamination may cause priming and foaming is indicated by the following analysis of a deposit from the steam space of a boiler:

Analysis of scale from steam space of boiler

	Percent
Oil	20.0
Silica	4.0
Iron oxide	8.2
Calcium carbonate	62.8
Magnesium carbonate	4.4
	99.4



Marine filter installations typical of oil-removal equipment in boiler plants

Oil is also carried over with sludge from the boiler water into the turbines and, becoming cooler as a result of the steam doing work, congeals and acts as a binder for other substances brought over by priming. The following analysis is representative of such a deposit:

Analysis of scale deposited by steam in turbine

	Percent
Oil	24.88
Silica	13.80
Iron and alumina	6.19
Calcium sulphate	0.03
Calcium carbonate	55.10
	100.00

Oil that exists in emulsion or a fine state of division must be coagulated prior to removal by filtration, and for this aluminum sulphate and caustic soda are used. Before entering the filters the condensate is given a treatment of approximately one grain of aluminum sulphate and ½ grain of caustic soda per gal. The resultant aluminum hydrate precipitate forms a flock that coagulates the finely divided oil particles, thus holding the oil on the surface of the filter bed.

Operation

The operation of the filter is very simple. The contaminated water enters the filter at the top and leaves from the lower connection. The entering water passes through the adjustable orifice, which causes sufficient resistance to shunt a small proportional amount of water through the coagulant tank, wherein it becomes saturated with alum and delivers alum to the filter side of the orifice at a rate proportional to the rate of flow through the adjustable orifice. When using sufficient coagulant, the filter bed retains the suspended matter at its surface and permits only a crystal-clear water to pass through. When the pressure loss through the filter bed becomes excessive, the filter should be cut out of service and back-washed.

"Rule of Thumb" Test for Oil

A helpful preliminary test for the determination of oil in boiler feedwater can be conducted by anyone. Just take an ordinary clean test tube, fill it to a depth of about 2 in. with the feedwater to be tested, and shake it in your hand for a few minutes with your thumb over the test-tube opening. If at the end of a short period of shaking there is an accumulation of oil globules on the surface of the water you can be almost positive that there is oil and plenty of it in the feedwater. If at the end of the shaking period there is no evidence of globules at all, you can be fairly sure that the amount of oil in the feedwater is quite small.

The above information was made available through the courtesy of Cochrane Corporation, 17th and Allegheny Avenue, Philadelphia, Pennsylvania.

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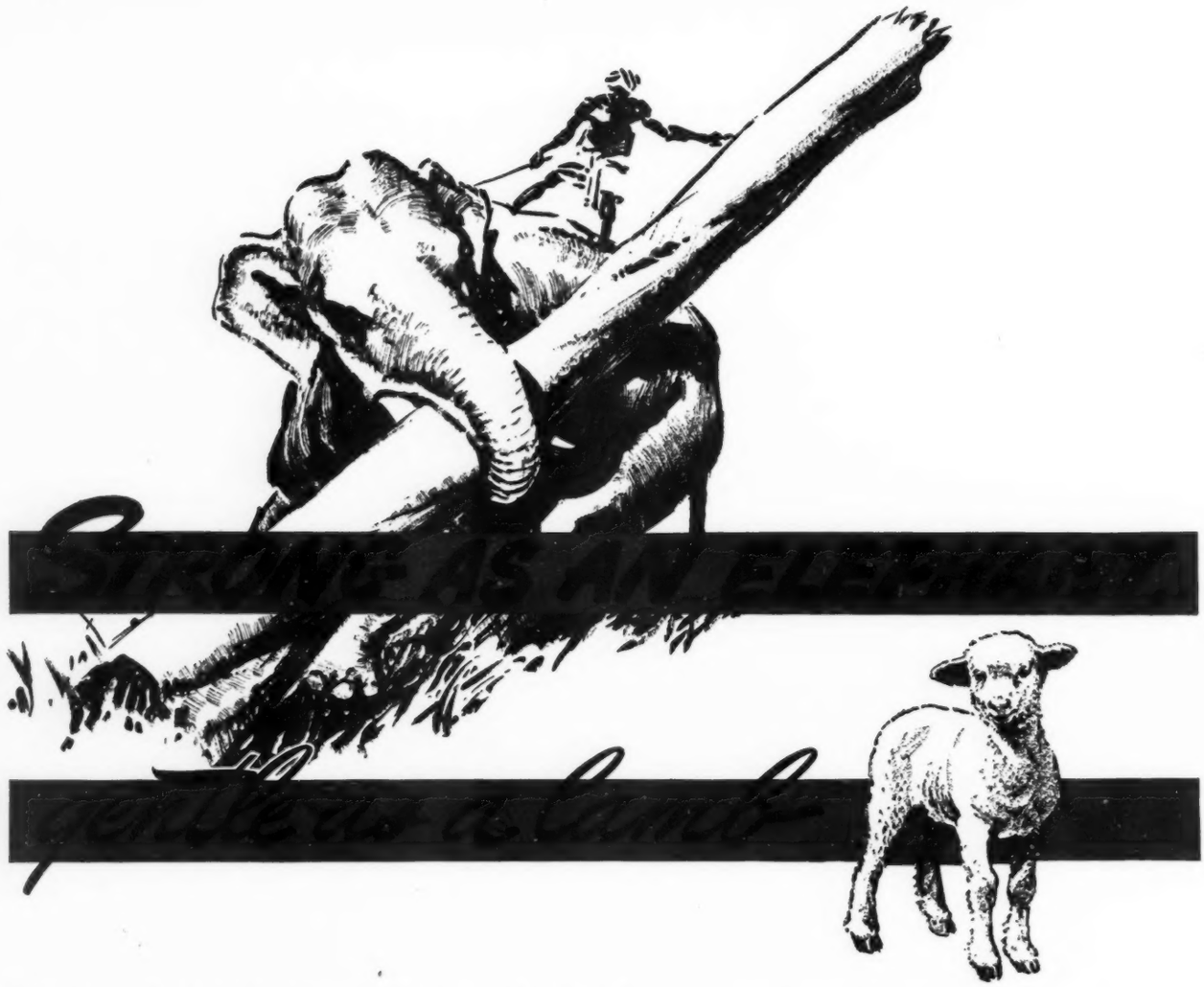

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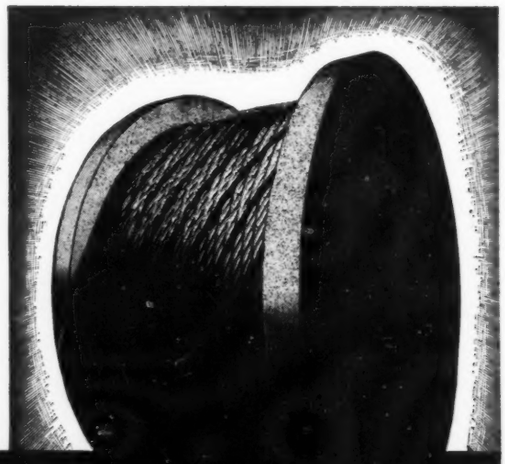
Extra strength plus easy handling make a combination that can't be beat for the hard-running jobs. Next time you buy . . . how about it?

PURPLE STRAND
FORM-SET
WIRE ROPE



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Trends in Rotary Drilling Machinery and Equipment*

Hydraulic drives, individual engines powering the rotary table, higher rotating speeds, and increased attention to lubrication are among the advances made in the last 15 or 20 years

by John M. Shimer

Equipment Engineers, Inc., Dallas, Texas

WHEN your president, Mr. Brantly, requested me to prepare and read to you a discourse on "Trends in Rotary Drilling Machinery and Equipment," the immediate reaction was that such a procedure would largely fall in the category of "carrying coals to Newcastle." Most of the drilling in this country is done by you contractors rather than by company tools, and you contractors may, therefore, be considered to be the ones who make the trends and to know so much about them that it will be difficult to include in this paper a great deal of information that is new to you.

Webster's dictionary defines the word trend as meaning figuratively "to drift," which gives the writer the desired latitude and permits him to drift back into the past, through the present, and into the future. It is common, in all walks and phases of life, for us to take our present blessings too much for granted without giving enough thought to how our daily experiences, painful as they may seem to be, can be utilized to further improve our situation in the future. Occasional reminiscing is often very beneficial in calling to our minds the mistakes we made in the past and in increasing our appreciation of the improved conditions under which we are working at the present, as well as enlightening us concerning even greater efficiency and productiveness in the future.

A Glance at the Past

Let us, therefore, begin by going back 15 or 20 years and taking a look at the equipment with which wells were drilled by the rotary method at that time. Mud pumps were merely cold water pumps modified but very little to fit them for the severe service of handling viscous abrasive fluids in large volumes, which required the pumps to operate at speeds and pressures much in excess of those for which they were designed. Mud pits were small and inadequate to permit settling of the cuttings and sand. Most of you can remember when it was necessary to overhaul the mud pump every tour. Pump liners were made of pipe and rods of cold rolled steel. Pistons and valves and seats were of designs and materials suitable only for clear cold water at relatively low pressures.

*Paper presented before American Association of Oilwell Drilling Contractors at Dallas, Texas, November 14, 1941.

JOHN M. SHIMER

received his degree in engineering from Lafayette College in 1914—From 1914 to 1920 he was engaged in air compressor and steam turbine work—In 1920 he became general superintendent of the Wilson Snyder Manufacturing Company, Braddock, Pennsylvania, and in 1923 assumed, in addition, the duties of chief engineer—When Wilson Snyder and Oil Well Supply Company merged in 1929 he became vice-president in charge of engineering of the latter, which position he held until May 1, 1941—He is now vice-president of Equipment Engineers, Inc.

The steam engines were of open frame construction with babbitted bearings and inadequate lubrication. These engines were geared to the hoist drums with such high speed ratios that the engine speed was excessive with the result that much down time and large repair costs were charged against this part of the rig.

The hoists were of the post type and were moved from location to location, piece by piece, and rigged-up between head board and sill with very questionable alignment of bearings, shafts, and sprockets. The sprocket teeth were rough cast and the chains were inaccurate as to pitch and roller alignment.

The rotary tables were made of cast iron with open gearing and the table and pinion-shaft bearings were totally inadequate for the service.

The swivels, blocks, wire lines, rotary hose, drill pipe, tool joints, mud line valves, and fittings were also of inadequate design and materials, with the result that a very large part of the total time on a well was spent in making repairs, to say nothing of the cost of the replacement parts. It is probably true that the technique of making hole with rotary machinery advanced much faster than improvements to the equipment during the period about which we are speaking and it is also true that during this period the depth of the wells being drilled was increasing rapidly. Nevertheless, a considerable part of the expense and waste was due to the lack of care of the equipment by the drilling crews and the contractors. The "run her till she breaks and then we'll get a new one" practice cost the industry great sums of money and filled many a slush pit with scrap iron prematurely. This apparent ambition of the drilling crews to tear up the equipment regardless of cost or of hole made, caused so much waste that no industry but oil could have survived on a like basis. Even today, trained engineers and mechanics from other industries shudder at the abuse and lack of care given the machinery of a rotary rig when they first set foot on the derrick floor. It is true that conditions are vastly better than they once were in this respect but much reduction in cost and elimination of waste is still possible. If even only a small percentage of this audience does some additional constructive thinking along the line of improved care and maintenance of rotary machinery, the time required for this look into the past will have been well spent.

Progress Has Been Great

Rotary drilling machinery has come a long way in the last 15 or 20 years. We now have anti-friction bearings effectively sealed against foreign matter, oil-bath lubrication, totally enclosed working parts, unitized hoist construction that permanently pre-

serves bearing, shaft, and sprocket alignment, and many other features that require precision manufacture and reduce maintenance costs.

Mud pumps are now made extra large and extra strong. The wearing parts are of super-hard, abrasion-resisting materials. It is not unusual to drill 50,000 ft. of hole with one set of pump liners and 10,000 ft. without so much as changing valve inserts. All this in spite of working pressures and volumes being at least three times those of 20 years ago. The steam ends of large modern steam pumps are capable of developing from 700 to 1000 indicated hp. when operating at piston speeds of approximately 165 ft. per min. (50 r.p.m., 20 in. stroke) and with 350-lb. boiler pressure. The introduction of the piston valve steam end to replace the old D-slide valve made possible the use of present-day high steam pressures and superheated steam and the great increase in the working capacity of the entire pump as well. The mud pump is the heart of the rig and it has been proved repeatedly that rate of penetration is determined largely by the working capacity of the pump. Power-driven pumps requiring an input exceeding 400 hp. to operate them to capacity are not uncommon. It pays to use a pump sufficiently large for the work and to keep it in the best of repair.

Next in importance to the mud pump is probably the hoisting engine. Modern steam engines are all of the twin type and of highest grade construction and materials. Anti-friction bearings, oil-bath lubrication, counterbalanced cranks, alloy-steel shafts, etc., are almost universally used, making for low maintenance costs and reliable performance. Many of these engines drill 100,000 ft. of hole and more without one cent of operating expense or one hour of down time. The larger sizes will develop 2000 indicated hp. at moderate piston and rotative speeds when connected to a 350-lb. steam pressure boiler plant.

In recent years internal-combustion engine power has made a prominent place for itself on rotary drilling rigs, especially for depths of 8000 ft. and less. Although there are a few power plants of this type, which include electric generators and motors arranged to form an electrical transmission system, most of the internal-combustion engine drives are connected to the mechanical type of transmission incorporating friction clutches and V-belt or chain drives for compounding the engines to drive the hoist. From the inception of the spark plug rig, the amount of power available for hoisting, has been proportionately less in all sizes than that demanded of steam rigs. The largest internal-combustion engine rigs of today do not exceed 1000-hp. output available for hoisting and consist of three engines that are connected by a compounding arrangement to drive the jackshaft of the hoist. The compounding arrangement permits of using two of the engines for driving the mud pumps and one for rotary table drive while drilling. It has been somewhat of a puzzle to the writer that the much smaller hoisting power of internal-combustion rigs has been found so satisfactory compared with the much greater power of engines demanded by operators of steam rigs of comparable drilling capacity. This possibly may be explained by the fact that in no case is the full capacity of the steam engine used or by the fact that it is not the practice to hold a stop watch on the spark plug rig crew when making a round trip in an effort to save the last split second of time. It is believed by the writer that much hoisting machinery has been torn up and worn out prematurely by the use of oversize steam engines. This type of abuse is automatically eliminated in the internal-combustion engine rig by the torque characteristics of the engines and by the fact that engines of larger capacity than about 350 hp. each are not sufficiently portable for oil-field work.

Recently a few installations have been made in which hydraulic couplings have been attached to the engines to provide an hydraulic cushion to relieve the engine crankshaft of shock loads caused by clutch operation and remove the destructive effects of torsional vibration. Hydraulic couplings do not increase the torque available. This device is not to be confused with the hydraulic torque converter, which consists essentially of a centrifugal pump and an hydraulic turbine, has the same dampening characteristics as to shock and torsional vibration as the hydraulic coupling, and in addition has the big advantage of torque multiplication. When the torque converter is used with the hoisting engine it acts as a variable speed transmission that automatically decreases the output speed as the hoisting load is applied. This characteristic is obviously ideal for hoisting service on a drilling rig. Unfortunately, however, large capacity torque converters have not yet been made available, the largest at present being capable of absorbing only about 350 hp. This condition will probably be overcome and larger units built after the defense program has been completed.

Independent Table Drive

Probably the most outstanding improvement in rotary rigs in the last few years is the independent drive to the rotary table in which a separate prime mover is used instead of the hoisting engine. This type of drive was first used on steam rigs where there are two types, one being the unit type in which rotary table, gear box, and twin vertical engine with flexible coupling connections are mounted on a skid frame and placed on the derrick floor in a position where there will be the least interference when bringing in, racking, and laying down the drill pipe. Another type of independent table drive on steam rigs consists of placing the twin steam engine below the derrick floor in the cellar when sufficient space is available and driving from the engine to the rotary pinionshaft by chain. In both types the steam engine has a remote throttle control and reverse located at the driller's position.

High Rotary Speeds

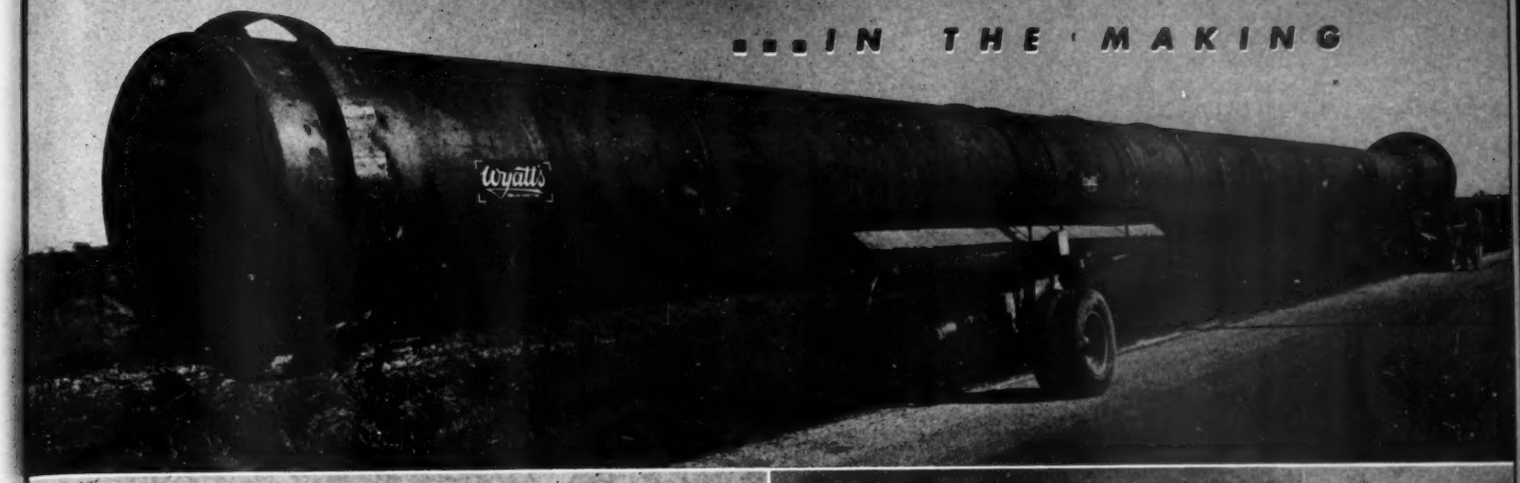
Rotary table speeds of 500 r.p.m. and higher are uncommon in the Mid-Continent area but are used quite generally in the deep wells in California. This type of service is very severe especially when taking into consideration that the horsepower requirements usually are calculated to be 1 hp. per revolution per minute or 500 hp. at 500 r.p.m. This figure obviously represents high torque combined with high bearing speeds and calls for rugged, precision built rotary tables adequately lubricated, perfectly balanced, and made of the very best materials. The modern rotary table represents probably the greatest advance in drilling machinery design. Having anti-friction bearings throughout, spiral bevel, accurately cut, surface hardened gearing, and complete oil-bath lubrication, it performs the most difficult job on the rig with a minimum of maintenance cost. It is not inconceivable that before long, table speeds of 1000 r.p.m. may become quite common.

Driving the rotary table with a separate engine adds a small amount to the first cost of the rig but this is soon paid for out of savings in operating expense. Using a 2000-hp. hoisting engine, operating at high speed to drive a rotary table, which on the average requires less than 500 hp. during all the time the bit is on bottom, obviously causes undue wear and tear on the larger engine and on the chain drives, which likewise are operating at excessive speeds. No engine is efficient at quarter load and there is, therefore, a considerable power loss and excess fuel consumption.

A separate engine for turning the rotary table makes possible the taking of an upward strain on the drill pipe with the hoisting engine while rotating and thereby drilling upward through cavings that may have fallen in above the bit and which otherwise might

Sentinels of Power

...IN THE MAKING



Self-Supporting Steel Smokestacks, sentinels of power in the making, are just one of the many types of giant fabricating jobs regularly rolling off the production line at Wyatt Metal & Boiler Works.

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cause stuck drill pipe and a fishing job. Likewise the breaking-out of the drill pipe while coming out of the hole is facilitated as there is no rotary clutch to operate.

The quiet operation of the independently driven rotary table, especially of the direct drive type, affords the driller a much more accurate conception of the condition of the bit, the effect of the weight on the bit and the proper speed for fastest penetration in each type of formation. Of great importance is the elimination of personal fatigue caused by excessive noise that reduces the alertness of the driller toward the end of a tour. It is believed that a considerable proportion of all fishing jobs can be traced to noises on the derrick floor that have dulled the driller's sensitiveness to changes in drill pipe and bit operation. Manufacturing industries have benefited greatly by the scientific study of human fatigue so why cannot the drilling industry do likewise?

It is now possible to obtain for spark plug rigs a separate engine drive to the rotary table that includes an hydraulic torque converter mounted on the engine. This hook-up permits the driller to control his table speed by means of a remote engine throttle control placed at the driller's position and eliminates the engine clutch, together with all possibility of stalling the engine. The hydraulic cushioning effect of the torque converter relieves the engine of all drill-pipe shocks and if excessive weight is put on the bit, the table merely slows down until this excessive weight is drilled off.

Severe Service on Swivels

Because of deeper wells with their heavier strings of drill pipe, rotating generally at much high speeds even with drag bits, the swivels on rotary rigs are put to severe service. The main thrust bearing must support a load of 100 to 150 tons while rotating at speeds of 500 r.p.m. and higher. In anti-friction bearings the load carrying capacity increases as the diameter and number of rollers or balls, but beyond a certain point the peripheral speed of these elements causes a reduction in load carrying capacity so that now we see the modern swivels made as compact as possible especially as to bearing diameter as against the exceedingly large diameter swivels of a few years ago, some of which required more than a barrel of oil to fill them. There seems to be considerable "hokum" in the rating of swivels as to their load carrying capacity and it is not unusual to see 300 ton and larger swivels advertised, yet you contractors will very often buy a certain swivel because you were told it had a capacity of 300 tons or more. How many of you have ever had such a load on a swivel at least while it was rotating? Any anti-friction bearing has a stationary crushing load capacity many times that of its useful wearing life when running at normal speeds and loads. The important question is how long will the swivel stay in service at normal drilling speeds and loads, not how much dead load will it carry.

Rotary Hoists Unitized

The unitizing of rotary hoists has done much to reduce rigging-up and moving costs. Cut-tooth sprockets and oil-bath lubrication of chains have reduced noise and maintenance costs. Improved jaw clutches have reduced shock loads and improved water-cooled brakes have lightened the driller's work materially. Shaft and drum sizes have been greatly increased but the largest hoists of today are exceedingly heavy and bulky. Isn't it possible that the pendulum has swung too far in the direction of hoists that are too heavy? Doesn't it seem rather ridiculous to buy a hoist that weighs 60,000 lb., costs $20,000, and greatly exceeds all legal highway limits as to dimensions and then only be able to load the largest drilling line practicable to a single line pull of about 30,000 lb. if long life is to be obtained? This extreme has been brought about by the mad desire to make faster round trips and is definitely related to the demand for the large hoisting prime movers mentioned earlier. Under the average conditions over the entire country the bit is on the bottom about 80 percent of the time, leaving 20 percent for round trips, changing bits, repairs to machinery, etc. If the round trip time could be reduced as much as 25 percent the saving would be only 5 percent of the total time and this is not enough to pay the extra first cost of the larger prime movers and hoists, the additional wear and tear on the drilling equipment and wire lines, and the excess power consumption. This practice is a clear case of "haste makes waste."

The Economic Problem

The time allotted to our subject does not permit a detailed discussion of the advances made in drilling bits, tool joints, rotary hose, weight indicators, etc., all of which have contributed greatly to the improved drilling technique of today. The modern rig in the hands of an experienced crew makes the drilling of holes 10,000 ft. deep as easy and rapid as was the case with 5000-ft. holes ten years ago. The cost per foot for maintenance and depreciation is much less. The first cost of the equipment is not proportionately higher, yet there is a persistent rumor going around that contractors cannot make a profit these days. Possibly this economic problem can be solved in part by each of you answering the following questions according to his own particular situation.

1. Is your drilling machinery and equipment receiving proper care and mechanical attention?

2. Are your rigs depreciating too rapidly because they are being used for work beyond the range of their capacity?

3. Do you actually know what your maintenance and depreciation costs are?

4. Are you consistently on the alert to improve the operating efficiency of your crews and their handling of the equipment?

5. Do you have in your organization technically trained personnel qualified to detect the mechanical superiority of one piece of equipment over another and to offer constructive suggestions to equipment manufacturers concerning needed improvements? You are competing with company tools that are backed by such facilities.

6. Are your rigs well balanced so that there is no bottle-neck or weak link, which if removed would permit the entire rig to operate more effectively? The old extravagant days when a contractor could make a profit by his physical strength and endurance alone are gone forever. Your business, like all others, requires mental effort and scientific management if you are to survive against competition and present-day low prices per foot. All you have to offer for sale is the use of your drilling equipment and the services of the men who operate it. Can you afford to do less then than to look for the numerous small leaks, some of which have been mentioned above, where profits dribble away to losses if they are not plugged?

The Future

The future will doubtless bring as many improvements in drilling machinery and equipment as has the past and by the same token, wells of 20,000 ft. in depth may be common in ten years or at least when economic conditions warrant deeper exploration. Equipment for this deeper work will be relatively more compact, lighter in weight, more efficient, and of greater precision of manufacture and will require more care and more skilled operation. The designs will be such as to eliminate shock loads that at present result largely from careless operation. We shall see greater refinements as to controls and a closer approach in the operation of a drilling rig to that of modern manufacturing plants.

——☆☆☆——

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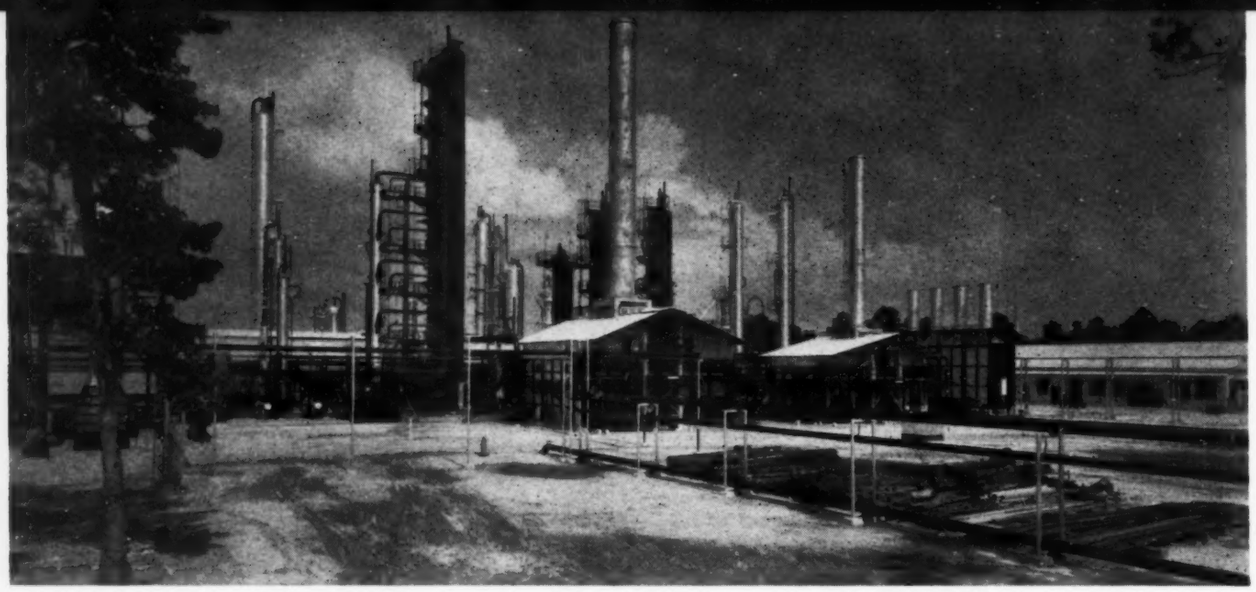


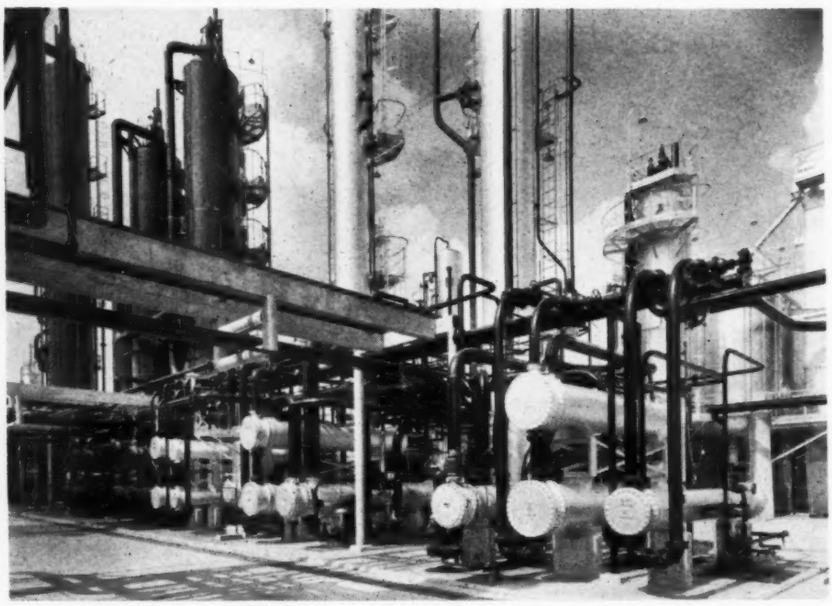
Topping, cracking, and thermal polymerization furnaces in foreground; main unit in background

Views of Continental Oil's Lake Charles Refinery

ON THIS page are shown views of the Continental Oil Company's new Lake Charles, Louisiana, refinery, additional to those published in the November issue of *The Petroleum Engineer* in connection with a complete description of the plant. The plant is designed to process a combination charge of 10,000 bbl. of crude oil and 6000 bbl. of 70-lb. PBC (propane-butane-casinghead) stock daily.

Indicative of the rapidity with which the scene is changing currently because of the war, although this refinery has been in operation only a few months, it has already been announced that a $375,000 addition will be made to the Lake Charles plant to increase the production of aviation gasoline.

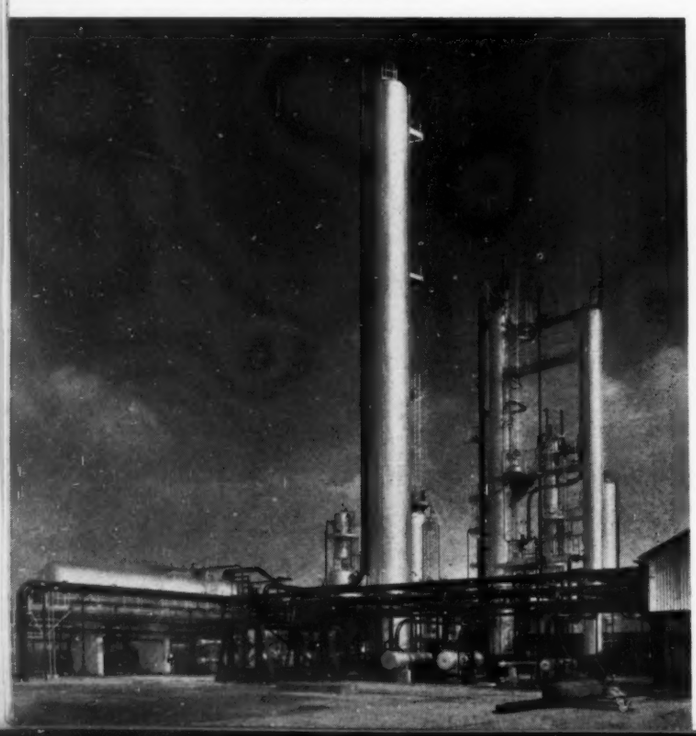
Continental Oil Company technologists and engineers worked closely with the M. W. Kellogg Company in the design and construction of the operating units of the Lake Charles refinery.

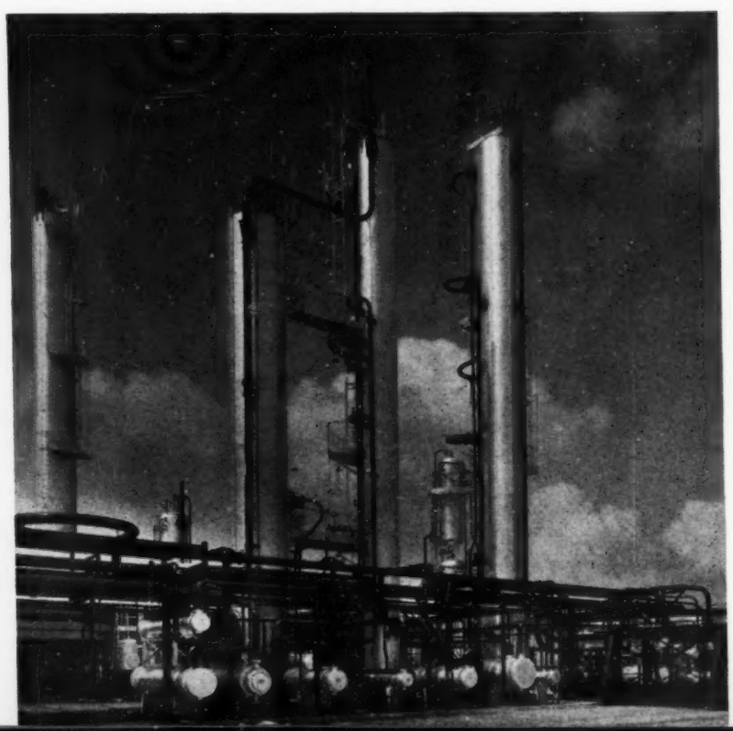


Topping and cracking unit exchanger bank

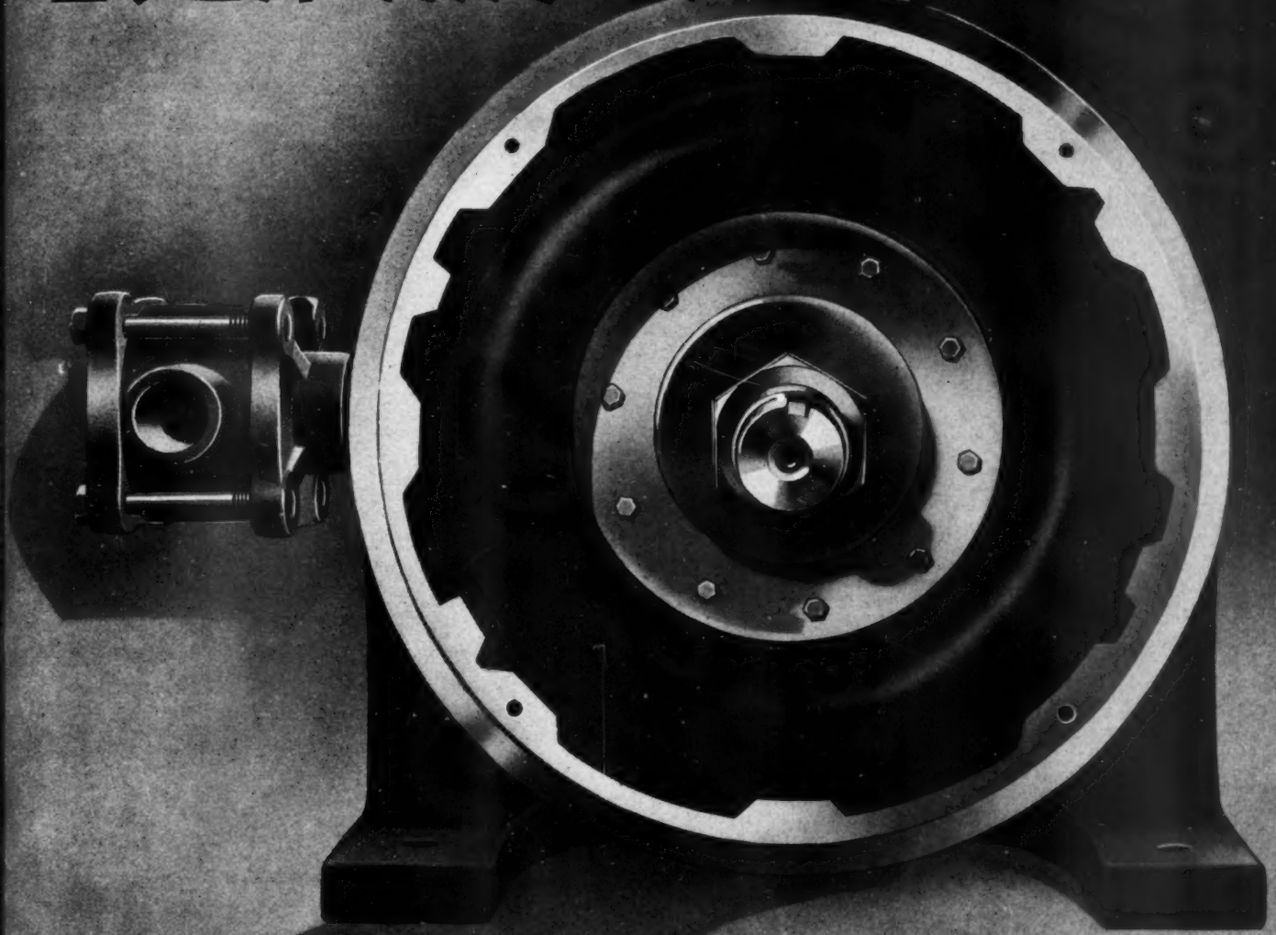
Depentanizer (left), partial stabilizer, depropanizer, and casinghead stabilizer

Alkylation unit





EVEN AIR GAPS!



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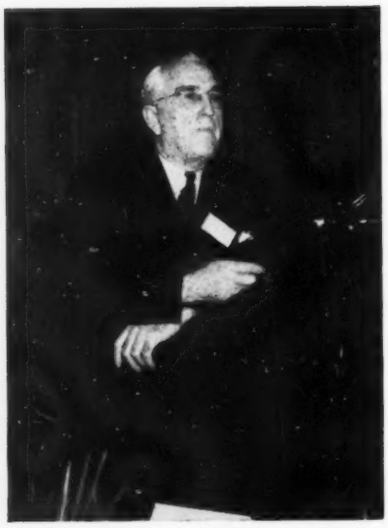
Priorities and the Drilling Contractor*

by W. L. Childs

Vice-President and General Manager, Reed Roller Bit Company



W. L. Childs addressing meeting of drilling contractors

FOR 75 years the supply companies and manufacturers of oil-well equipment have taken care of your needs as drilling contractors. During that whole time they have been able to serve you, night and day, including Sunday. Along about the first of the year we saw that we could not do that any more unless we became very active in getting oil rated as a necessary defense priority.

As you probably know, a priorities committee representing oil materials manufacturers was appointed to go to Washington to discuss this matter with the Petroleum Coördinator's Department and with the OPM.

Now, when our committee appeared before Donald Nelson—and believe me gentlemen, there is a real man, and we ought to be glad he heads the OPM because he knows what it is all about—and approached him with a letter from the chairmen of the five districts telling what was going to happen unless we got supplies and materials, a letter from the Petroleum Equipment Suppliers group, telling them what was going to happen unless they got materials, Mr. Nelson registered great surprise. It seems that the oil companies had bragged just a little too much on their ability to supply all the oil that would be needed in any emergency. That part of it they had picked out of somebody's speech! They did not pick out the fact that in order for the oil companies to supply all the oil that would be needed there would have to be a lot of drilling done; that part was left out, so Mr. Nelson said, "My gracious, men, this is a terrible surprise to me." He thought all you had to do was to turn on the spigot, and the oil would flow, flow, and flow, and there would not be much necessity for the use of steel in producing the extra oil that would be needed for this emergency. We informed him, of course, that that just could not be done.

So the obtaining of orders has been handicapped considerably by the fact that the folks in Washington really believe that all you have to do is to turn the valves on if you want more oil. You probably could do that in a few sections, but you can't do it in all sections, because there are, I think, 396,000 wells in the United States and there are only about 48,000 that will produce, as I understand it, under their own head. All the rest are pumpers, and those that will produce under their own pressure would not produce very long if they were opened very wide.

Now they tell us we must drill more wells with less steel. We will have to figure out exactly how to do that. It probably can be done. We were told in Fort Worth that there has to be 5 percent more production with 30 percent less materials. With such a shortage of materials, we naturally supposed there would be a curtailment of drilling. At Washington they said they wanted 30,000 wells next year. You can't curtail very many materials if you drill that many wells! So it looks as though we will be pretty busy for quite some time.

The OPM has a job just ahead of it. Take just the matter of steel. The steel capacity in this country is 86 million tons. When you need more than you have what are you going to do? Can we open up and let the civilians have all the steel? The problem of dividing it is done under the priorities system. Priorities are an equitable way of dividing materials in a manner that will give big and little industries, big and little purchasers, their fair share.

And believe me, gentlemen, were it not for the priority system there would be inconceivable chaos in this country right now. Some of us think our troubles are entirely due to the priorities. That is not the trouble, gentlemen. The real trouble is a shortage of vital materials.

The Petroleum Coördinator tells us that 30,000 wells should be drilled in '42; that in order to carry out the petroleum program, materials and supplies will be needed in the following amounts:

Production	3,175,000 tons
Transportation	1,843,000 tons
Refining	647,000 tons
Marketing	181,000 tons
or a total of	5,846,000 tons

Now, the question is, how shall we get this amount of tonnage? At the present time there are two ways.

First, through the use of PD-1's, which should anticipate your requirements 90 days in advance. This order takes care of capital investments such as the purchase of a new drilling rig.

Second, Preference Rating Order P-22. This order allows you to originate an A-10 rating for materials that you use for maintenance, repair, and operating supplies.

Coöperation on the part of the petroleum equipment industry and the petroleum producers has made these orders available to you.

How can you coöperate with us?

It is only through the use of the rated purchase orders under P-22, that adequate stocks of materials on supply store shelves can be assured. Hence, it is imperative that you begin to rate your orders for equipment used for maintenance, repairs or operating supplies. Now, there are a lot of you who have refused to do this. There are a lot of manufacturers and suppliers who have not asked you to do it, but I am telling you, gentlemen, that it will not be many weeks before you will be compelled to do it if the manufacturers and suppliers are to have equipment available for your use. So be coöperative in this. By coöperating in this matter, the priority orders may be made to function smoothly and efficiently, and future stocks of material will be guaranteed to supply stores so that they may continue to give you prompt service in any emergency. [Editor's note: Subsequent to Mr. Childs' address, Preference Rating Order No. P-83 was issued on December 8, 1941. The text of this order may be found on page 121 of this issue.]

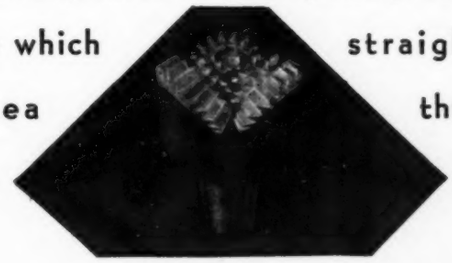
☆☆☆

*Digest of an address before the American Association of Oilwell Drilling Contractors, November 14, 1941.

U. S. S. Buckthorn . . . Net Tender

"Tailor-made" for the job!

Anti-submarine nets protect ports and harbors against surprise attack. The net tender is especially designed for laying and tending these protective barriers which keep out under-sea marauders . . . .



This specialization of design applies also in the drilling of oil wells . . . Hughes Rock Bits are especially designed to make fast, straight, full-gage hole through each range of formations.

Hughes Tool Co. Houston, Texas

LAUGH WITH BARNEY

A farmer was relating to some friends his experience on a recent visit to a college town: "I was standing in front of the big concrete barn countin' my money when some guy yanked five bucks out'a my hand and gave me two and a half in change and a piece of cardboard. A whole mob of people in fuzzy coats pushed me through a door and another guy grabbed the cardboard and tore it to pieces and gave me back half of it.

"Here I was inside . . . and the darn barn didn't have a roof on it, but it had seats all around . . . full of people yellin' like hell. Out on the lawn were a bunch of kids squattin' and runnin' and throwin' a bunch of leather balls. One bunch had on red knee pants, red sweaters and leather hats and the other gang had on the same thing only it was all blue.

"I just got set down when four birds in white knee pants and black and white shirts come runnin' out on the lawn, one of 'em whistled and the guys with the leather hats lined up, one of 'em stuck his nose in another guy's fanny and the damdest fight started you've ever seen."

* * *

Boy: Daddy, if you give me ten cents, I'll tell you what the iceman said to mamma.

Dad (all excited): O. K., son, here's your dime.

Boy: He said, "Do you want any ice today, lady?"

* * *

"Your fiance is really a charming fellow. He seems to have that certain something."

"Yes, but I'd rather he had something certain."

* * *

A returned vacationist, waxing eloquently about his visit to the Grand Canyon, was getting boresome.

"The soft curtain of night was just falling," he orated impressively, "and there I stood, drinking in the scene with that vast abyss yawning."

"I say," interrupted a listener, "was that abyss yawning before you got there?"

* * *

Running after women never hurt anybody—it's catching them that does the damage.

* * *

She: Do you know what they're saying about me?

He: Why do you think I came over to see you?

Work doesn't wear us out; it's dreading it that unravels our nerves.

* * *

"Who was that lady I seen you out with last night?"

"I wasn't out. I was just dozing."

* * *

A young lady was on a sight-seeing tour in Detroit. Going out Jefferson Avenue the driver of the bus called out places of interest.

"On the right," he announced, "we have the Dodge home."

"John Dodge?" the lady inquired.

"No, Horace Dodge."

Continuing out Jefferson.

"On the right we have the Ford home."

"Henry Ford?"

"No, Edsel Ford."

Still farther out Jefferson.

"On the left we have Christ Church."

A fellow passenger hearing no response from the young woman, tapped her on the shoulder and said:

"Go ahead, lady, you can't be wrong all the time."

* * *

Then there's the bachelor who got thrown out of his apartment when the landlady heard him drop his shoes on the floor twice.

* * *

As a motorist drove by a military hospital a nude soldier dashed toward the highway. His clothing was gone but he retained his glasses. Pursuing him closely was a female nurse brandishing a pair of long shears. Behind these two raced a doctor.

"No, no, nurse," yelled the doctor, "I said 'slip off his spectacles'."

* * *

Pretty Co-ed: Wonder what's the matter with our big, handsome football hero—he looks so blue?

Her Frosh Escort: His father is always writing to him for money.

* * *

Some girls like a man who loves 'em and leaves 'em. Provided he leaves 'em enough.

* * *

Sentry: Halt; who's there?

Voice: American.

Sentry: Advance and recite the second verse of "The Star Spangled Banner."

Voice: "I don't know it."

Sentry: Proceed, American.

* * *

"Is your husband a book-worm?"

"No, just an ordinary one."

Teacher: Now, children, every morning you ought to take a cold bath; and that will make you feel rosy all over. Are there any questions?

Boy in back of room: Yeah, teacher, tell us some more about Rosie.

* * *

A woman gave a cripple 25 cents and remarked sympathetically:

"It must be terrible to be lame, but I guess things could be worse. Suppose you were blind."

"You're right, lady," replied the beggar. "I tried being blind and people were always giving me counterfeit money."

* * *

Spinsters

The three Chinese sisters who aren't married:

Tu-Yung-Tu
Tu-Dumb-Tu
No-Yen-Tu

* * *

Gladys: Last night Ben tried to put his arm around me three times.

Thelma: Some arm, I'd say!

* * *

If she looks old, she's young; if she looks young, she's old. If she looks back, FOLLOW HER.

* * *

"Won't your wife hit the ceiling when you go in this late?"

"Probably will . . . she's a hell of a shot."

* * *

Doctor (as he examined patient's shins): Do you play hockey?

Patient: No, bridge.

* * *

There is always a tie between father and son—and the son usually wears it.

* * *

Groom: How did you make this cake, dear?

Bride: Here's the recipe. I clipped it from a magazine.

Groom: Are you sure you read the right side? The other side tells how to make a rock garden.

* * *

Silly Question

"Did you miss your train, sir?"

"No, I didn't like it's looks so I chased it out of the station."

* * *

Two travelers in Ireland, returning home late one night, lost their way.

Said one, "We are in a cemetery; this is a gravestone."

"Whose is it?" asked the other.

The more sober of the two, having struck a match, said, "I don't know, but he seems to have lived to a good old age—175."

"See, can you read the name?" insisted his companion.

Another match having been lit—"I don't know him, some fellow called Miles from Dublin.

THE TIME TO DO A CEMENT JOB IS THE FIRST TIME...

and your best chance for a successful "first-time" cement job is to use Baker Cement Whirler Equipment . . . which has proved by field results to afford best possible cement distribution at the critical point, the shoe joint.

Channeling at the shoe joint often necessitates a re-cement job which means additional time and added expense. The whirling action afforded by Baker Whirler Equipment gives best possible assurance of uniform distribution of the slurry entirely around the casing at the shoe joint and for a maximum distance up the pipe.

The effective Baker whirler principle is available in several types of Baker Cement units . . . a Baker Cement Wash-Down Whirler Float Shoe, a Baker Cement Wash-Down Whirler Guide Shoe, and a Baker Cement Float Collar in combination with a Wash-Down Whirler type of Shoe.

Complete details concerning Baker Cement Whirler Equipment, as well as other units making up the Baker line of Cement Guiding, Floating, Cementing Equipment will be found in the 1941 Composite Catalog; or, additional information may be secured from your nearest Baker office or field representative.

BAKER OIL TOOLS, INC.

Main Office and Factory:
6000 So. Boyle Ave., Los Angeles, Calif., Box 127, Vernon Station
Central Division Office and Factory: P. O. Box 3048, Houston, Texas
Export Sales Office: 19 Rector Street, New York City

Running Tour

WITH MEN IN THE INDUSTRY

HAROLD A. GREEN, of the Standard Oil Company of New York, has returned to the United States from Budapest, Hungary, where he has been stationed for the last 6 years. Green, who lives in Franklin, Pennsylvania, reported that the company's work in Budapest has been completed.

JOHN R. SUMAN, vice-president, Humble Oil and Refining Company, Houston, Texas, was honored at a dinner in Houston given by the Gulf Coast Chapter of the American Institute of Mining and Metallurgical Engineers. Suman is president of the Petroleum Division of A.I.M.E.

O. V. HENRY, who has been production superintendent for several years of the Haynesville and Cotton Valley fields, Louisiana, for the Ohio Oil Company, has been transferred to Mount Pleasant, Michigan. E. B. CHARLTON, superintendent of the pipe line and gasoline department for the Ohio Oil Company, is now superintendent of both departments.

C. C. CLINE has been elected county chairman of the Cattaraugus County, New York, Petroleum Industries Committee at a meeting held in Olean, New York. E. D. CRAY, secretary of the State Petroleum Industries Committee, New York City, was a principal speaker at the meeting.

R. N. BILLS, engineer, Amerada Petroleum Corporation, has been transferred from Plaquemines, Louisiana, to Lake Charles, Louisiana.

E. N. CARLSON, of Wichita, Kansas, succeeds E. C. MORIARITY, Wichita, as vice-president for Kansas of the Independent Petroleum Association of America, being elected at a special meeting of the Kansas directorate. Moriarity has been named to the executive committee.

FRANK HORNE, 42, for the last 5 years general superintendent of the Bareco Oil Company refinery at Barnsdall, Oklahoma, died November 15. A war veteran and prominent Rotarian, Horne is survived by his widow and two children. He died after a three weeks' illness.

WALLACE F. ARDUSSI is now in charge of research and product development for Foote Bros. Gear and Machine Corporation, Chicago, Illinois, according to an announcement by W. A. BARR, president and general manager. Ardussi has a background of 10 years' experience with Chrysler Corporation where he progressed through the positions of research and development engineer, manufacturing and production research engineer, assistant to the president of the Airtemp Division of Chrysler, and assistant sales manager of the Airtemp Division.

ROBERT B. WOLCOTT has been appointed manager of sales of the New York City office of South Chester Tube

ROBERT B. WOLCOTT

Company. Wolcott has been a sales representative with the South Chester Tube Company in New York for more than 15 years.

HARVEY L. WILLIAMS, JR., recently joined the Hawkins-Hamilton Company, Richmond, Virginia, as a sales engineer. He has been with A. M. Gathright and Company for the last 10 years. With the Hawkins-Hamilton Company, he will do engineering sales work in the Richmond territory for Cochrane Corporation, Hays Corporation, Nash Engineering, Northern Equipment, Terry Steam Turbine, Andale Company, Detroit Stoker Company, Micro-Westco, and Crosby Gage and Valve Company.

W. G. WARNOCK, formerly eastern division construction superintendent for Mid-Continent Petroleum Corporation, Terre Haute, Indiana, has been appointed manager of priorities for the corporation. Warnock is now in Tulsa, Oklahoma, and has taken up his duties in association with the purchasing department in collaboration with S. L. GILLIAM, purchasing agent. MARVIN THOMAS, former assistant construction superintendent of the corporation's southern sales division in Tulsa, has been transferred to Terre Haute to succeed Warnock.

K. W. HALEY has been transferred to Corpus Christi, Texas, from Olney, Illinois, by the Barnsdall Oil Company.

W. E. MORRISON, Pipe Line Department, Sinclair Refining Company, has returned to Tulsa, Oklahoma. He had been loaned to the National Defense Pipe Lines, Inc., with offices in Columbus, Ohio.

DON E. MCMAHON has been made manager of Nicklos Drilling Company with offices in Houston, Texas, according to an announcement by E. J. NICKLOS, president of the company.

KENNETH R. TEIS, Tulsa, Oklahoma, consulting engineer, is now chief petroleum engineer for the Sunray Oil Company.

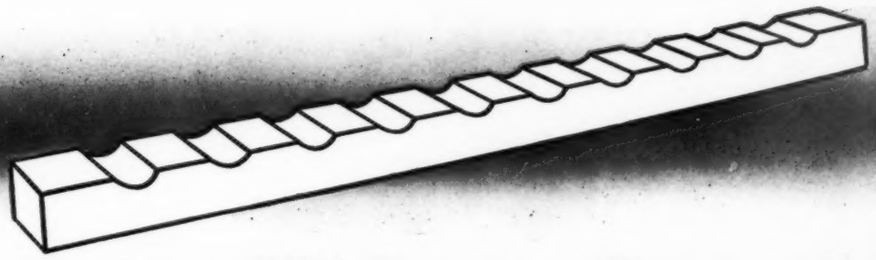
E. W. JARVIS, Standard Oil Company of Kentucky, has been named a member of the railroad transportation committee of the American Petroleum Institute, succeeding A. M. STEPHENS.

V. E. COTTINGHAM, chairman of the North Basin Pools Engineering Committee, presented a review of the Permian Basin development to the Fort Worth, Texas, Petroleum Engineers Club recently.

JAMES W. GALLAGHER, who recently returned from a 2-year assignment in Egypt, is visiting at his home in Tulsa, Oklahoma. He is to leave soon for Caripito, Venezuela, in the employ of the Standard Oil Company of Venezuela. Before becoming associated with Standard Oil Company of Egypt, Gallagher was with the Carter Oil Company, St. Elmo, Illinois.

REX LA FOLLETTE, former sales representative for Oil Well Suply Company in Tulsa, Oklahoma, has been transferred to the Oklahoma City office of the company. BOB HUFSMITH, from Cut Bank, Montana, is now in the Tulsa territory.

Better protection for Sucker Rods



means more efficient oil production

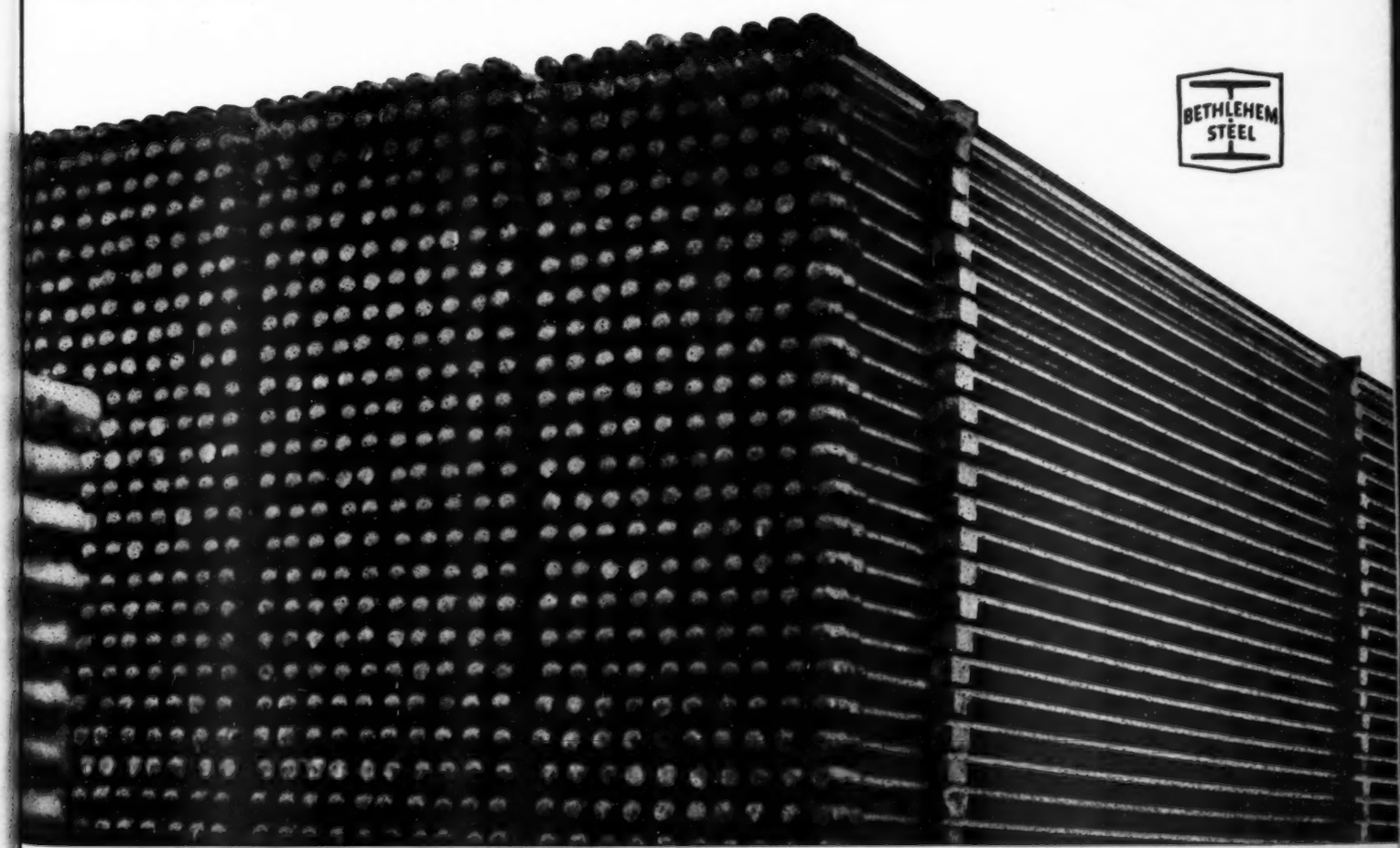
Here's a special wooden spacer that's becoming increasingly important now that efficient oil production is more vital than ever. Bethlehem's wooden spacers for racking sucker rods are ideal for protecting rods against kinks and bends while in stock, during transit, or on location during servicing. Then, too, these spacers speed up racking and make the job easier in every way.

Bethlehem spacers are included with every shipment of Bethlehem Sucker Rods. The rods are packed and anchored on the spacers when leaving the Bethlehem plant. You can use and re-use them during all your unloading and loading operations to keep your Bethlehem rods in the same sound condition in which they came to you.

Get your next string of rods from Bethlehem and find out what a time saver and rod investment protector these Bethlehem spacers can be.

Have you tried a string of Bethlehem X Mayari Rods?

For heavy pumping in corrosive wells it's hard to beat Bethlehem's famous X Mayari sucker rod. These rods are made of special-analysis, nickel-chromium steel and are fully normalized—not heat treated. They have exceptional strength, toughness, and resistance to fatigue and impact.



BETHLEHEM STEEL

BETHLEHEM STEEL COMPANY

GUS A. BARNES, J. C. TEAL, and E. A. KERMOTT, Socony-Vacuum Oil Company at Kansas City, Missouri, were presented gold, diamond-studded 20-year service pins by L. L. MARCELL, general manager of the White Eagle Division of the company.

JOSEPH E. WASHINGTON has been appointed field representative for Illinois under WIRT FRANKLIN, director of production, Region 2, Office of Production Coördinator, Chicago, Illinois.

GEORGE COX has retired after 30 years in the production department of the Continental Oil Company. His residence is now in Santa Ana, California. Cox entered the employ of Continental in 1907, at Florence, Colorado, as rig builder and tool dresser. At the time of his retirement, he was district foreman of the Rocky Mountain Division, headquartering at Shiprock, New Mexico.

GEORGE COX

A. J. EDWARDS, Black, Sivalls and Bryson, Inc., general sales manager, recently made an extensive business trip to the eastern cities of Chicago, Illinois, Pittsburgh, Pennsylvania, and New York, New York.

B. M. BRADLEY, engineer for the Continental Oil Company, Anahuac, Texas, has been transferred to Tulsa, Oklahoma.

JOHN L. CONNER, Shreveport, Louisiana, has been appointed executive assistant to Conservation Commissioner JOSEPH L. MCHUGH. He has been serving as acting head of the Minerals Division since McHugh succeeded WILLIAM H. HODGES, JR. HARRY W. BELL, also of Shreveport, has been appointed director of the Minerals Division succeeding McHugh.

W. J. THOMAS has been transferred to the executive department of the sales offices of The Babcock and Wilcox Tube Company at Beaver Falls, Pennsylvania. Thomas had spent 9 years in the process equipment division of the company. He was formerly associated with the Petroleum Iron Works at Sharon, Pennsylvania, as assistant manager of sales.

T. D. TABBERT has been transferred by the Shell Oil Company, Inc., from Perry, Oklahoma, to Pampa, Texas.

CECIL IRBY, Turner Petroleum Corporation engineer, Mt. Pleasant, has been elected chairman of the Michigan Chapter of the American Petroleum Institute for 1942. Irby succeeds MARSHALL R. JOY, Cities Service Oil Company, who has been chairman of the chapter since its organization two years ago. Other officers for 1942 elected by the chapter were A. ELLEN MORROW, C. L. McGuire, Inc., Mt. Pleasant, first vice-chairman; WALTER FRANKS, Gordon Oil Company, Grand Rapids, second vice-chairman; GLEN SLEIGHT, Sun Oil Company, Mt. Pleasant, secretary-treasurer. New members of the advisory board include Joy, W. A. THOMAS, Ohio Oil Company; WILLIAM BROWN and C. L. BENEZETTE, Oil Well Supply Company, all of Mt. Pleasant, and GUY ANDERSON, The Pure Oil Company, Reed City.

C. V. QUINN, Warren Petroleum Company superintendent at Fairbanks, Texas, is now at the plant on the Pure Oil Company properties in the Cumberland field. His headquarters are at Madill, Oklahoma.

W. J. PRICE, Colombian Petroleum Company, drilling superintendent at Cucuta, Colombia, is at present vacationing in the United States.

GUY A. DAVIS is now vice-president and general manager of the Highland Oil Company, recently reorganized and moved to San Antonio from Houston, Texas. WILLIAM H. SPICE, geologist of San Antonio, was elected president and director of the company, which has merged its properties with those formerly developed in Southwest Texas under the name of Davis. E. D. MILLER is secretary-treasurer and G. H. STOLTE is assistant secretary. Other directors are LEON F. RUSS, Dallas; A. M. RUSS, San Antonio, and W. L. GOLDSTON, Houston.

W. W. FUELL is now office manager for Hickok and Reynolds, West Central Texas operators headquartering in Cisco, Texas. Formerly auditor for the company, Fuell succeeds the late R. DANIEL.

P. E. FITZGERALD, geologist, Dowell Incorporated, Tulsa, Oklahoma, presented a discussion of laboratory studies of core acidizing under high pressure to members of the Engineers Club of Tulsa, November 24.

J. E. BRANTLY, president of Drilling and Exploration Company and president of The American Association of Oilwell Drilling Contractors, is now in South America making an inspection tour for the Brazilian Government and private operators in other countries.

J. M. LINEHAN was recently appointed general superintendent of the Mid-Continent Pipe Line Company, Tulsa, Oklahoma. He formerly served as assistant to J. A. BEYHAN, deceased. Linehan has been with Mid-Continent since November, 1933. Prior to assisting Beyhan he was superintendent of the system's southern division.

J. M. LINEHAN

FRANK FRANKEL, Frankel Bros., has been transferred from Long Beach, New York, to Houston, Texas.

ROBERT RUSSELL, of The Texas Company, Caracas, Venezuela, was guest of honor at a luncheon meeting of the Houston Chapter of Nomads, November 18. Russell in a brief talk outlined some of the problems confronting the oil man in that territory. Also among those attending the luncheon were J. C. VAN DE BERG, Shell Oil Company, and C. F. BEDFORD, Stanolind Oil Company.

NORMAN E. DONNELLY has been appointed marine sales manager for The Buda Company. Well known in the marine trade, Donnelly was formerly associated with the Caterpillar Tractor Company as their eastern engine sales manager. He succeeds FRANK FLICK.

OTIS REMOVABLE BOTTOM HOLE REGULATOR

No more surface freezing—no more expensive heaters—no more high surface working pressures. An Otis Removable Bottom Hole Regulator provides the safest and most economical way to stop freezing at surface controls.

Remove the point-of-pressure reduction from the surface to the bottom of the well and take advantage of the natural formation heat to offset temperature loss due to gas expansion. The well acts as a "Mile Long" heater—the most practical heater known.

Surface pressures remain relatively constant and are predetermined by adjusting regulator before installation. The rate of flow may be changed by merely regulating the surface choke . . . the Bottom Hole Regulator responds automatically to surface adjustment.

The Regulator is run and pulled under pressure on an ordinary steel measuring line. Otis Service crews are available in most high pressure areas and normally require only a few hours for complete installation.

Write for Complete Information and Details

OTIS PRESSURE CONTROL, INC.
DALLAS, TEXAS

PRESSURE CONTROL - OTIS - SERVICE - EQUIPMENT

Branches: Oklahoma City, Okla.; Houston, Texas; Hobbs, N. M.
Representatives: Otis Eastern Service, Inc., Wellsville, New York; Western Pressure Control, Inc., Los Angeles, California
Export Office: 74 Trinity Place, New York City

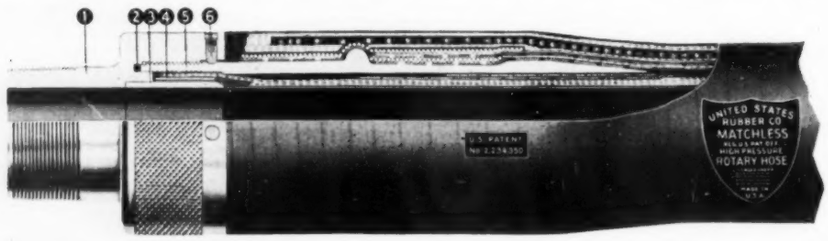
MACHINERY and EQUIPMENT

Built-in Rotary Hose Coupling

UNITED STATES Rubber Company, New York, New York, has issued a detailed drawing of the built-in coupling on its newest type of rotary hose.

The assembly drawing reveals that the coupling, which is used on both U. S. Matchless and Peerless brands is an integral streamlined part of the hose itself, requires no flanges, nozzles, bolts, nuts, clamps, or hydraulic nipples, and provides a full hole connection.

By the use of a special type of cap and expansion ring a coupling is provided that is said to be leakproof and to actually tighten the seal as the pressure increases. Male threads are provided on both ends of the hose, and additional connections are minimized.



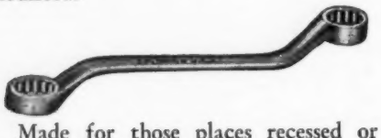
This construction, the manufacturer says, has been developed to meet increasing demands of the oil-producing industry. Frequent, fast changes involve heavier and larger equipment, deeper and deeper drilling, and constantly increasing pressures. These make necessary the utmost in caution and accomplishment in hose and coupling design.

The manufacturer states that this streamlined type of built-in coupling represents the answer of their engineers to the problem. It has been tested in both the laboratory and the field, for nearly two years, under the most extreme conditions, and is at present operating successfully on many widely varied drilling jobs, the makers state.

Key to cut-away drawing of built-in coupling on newest type of rotary hose is: (1) coupling cap; (2) end cap seal; (3) expansion ring protector; (4) expansion retaining ring; (5) built-in nipple; (6) coupling cap anchor seal.

Stubby Box Wrench

THE Plomb Tool Company, Los Angeles, California, has developed an extremely useful set of four short, 12 point, offset box wrenches, with an obstruction clearance of $\frac{9}{16}$ in. and overall length of 5 to 6½ in., it is announced.



Made for those places recessed or hidden with limited space, such as fuel pumps, starters, carburetors, and instrument panels on automobiles; in aviation, industrial assembly, and maintenance work, their compactness greatly increases the utility of this type wrench, it is asserted.

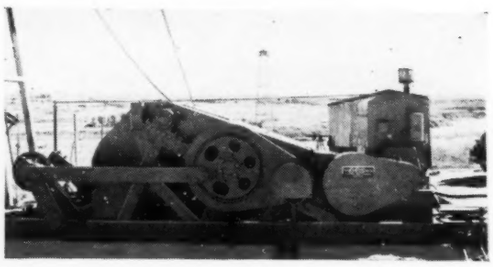
The short shank may be held almost entirely within the hand and accurately placed in position with greater speed and safety.

Made of the finest steel, full plated with polished heads, they are sold as a set in a canvas bag No. 8100A, or singly — if desired — and come in the following openings:

No. 8160—⅜ by $\frac{7}{16}$
No. 8161—½ by $\frac{9}{16}$
No. 8162—⅝ by $\frac{11}{16}$
No. 8163—¾ by $\frac{13}{16}$

OCS Builds "Workover Rig" with Unusual Feature and Steam Flexibility

A UNIT said to be of entirely different design and designed to work equally well as a cable-tool or a rotary workover rig and utilizing the principle and flexibility of a steam-driven machine has been perfected and is designated as "OCS Workover Rig." In fact, it can be changed from a cable-tool workover rig to a rotary workover rig within 30 minutes and vice versa. For cable-tool work the machine is designed for drilling, spudding, swabbing, and bailing operations. For rotary work it is designed to do anything that may be necessary. The Oil Country Specialties Manufacturing Company of Coffeyville, Kansas, assert the new "Workover Rig" is in response to requests from customers for a different kind of rig that would operate like a steam unit and be equipped with all friction clutches and minimum center of weight.



OCS Workover Rig, showing spudder arm side

Speed flexibility against varying weight and load conditions is a feature of the "Workover Rig." By the use of a Twin Disc Torque Converter the line speeds increase as load decreases, thus permitting speed to be automatically increased as much as 5:1 without changing ration. Likewise, the pull can be increased in any given speed by as much as 5:1 without changing ratio.

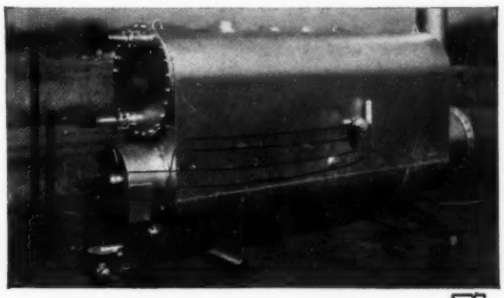
Speed can be changed, it is stated, without shutting down. The operator merely goes from high to low on the hoist drum by throwing out one friction clutch and throwing in the other. The unit has no gear box to strip.

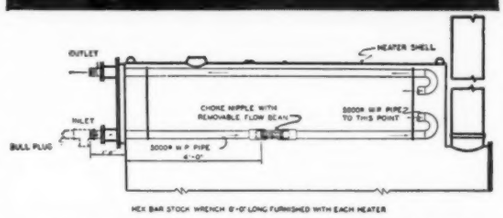
Even the sand reel of the "Workover Rig" has two speeds. Line speed can be increased as much as 5:1 in either one of the two speeds. The spudder arm drive has two speeds that permit drilling and agitating from 6 SPM up, with engine running at satisfactory operating speed.

Indirect Heater Prevents Hydrate Freezeups

A SAFE "water bath" type of flow line heater has been developed by Black, Sivalls and Bryson, Inc., Oklahoma City, Oklahoma, for heating high-pressure gas or high-pressure gas and oil mixtures, it is announced by the manufacturer. In the lower part of the heater shell a welded horizontal tubular firebox is installed. A removable fluid tube bundle constructed from pipes is bolted in place above the horizontal firebox. The entire shell is completely filled with water before operation is begun.

Heat is transferred first from the firetubes to the surrounding fresh water and then from the water through the walls of the flow tubes into the gas or oil passing through. The BS&B "submerged positive choke" (installed as shown in the cross-sectional drawing) eliminates freezing at the choke, which usually occurs when heaters are set upstream near the wellhead, and eliminates the use of expensive extra-heavy pipe in the flow tube bundle made necessary when the heater is set downstream. With this choke the necessary pressure reduction takes place within the hot water bath section of the heater. Any possible hydrate formation will occur at the choke or immediately downstream from it. Because of the surrounding hot water the hydrates will be melted before the choke or line is plugged.





BS&B indirect heater. Diagram shows positive choke for high-pressure indirect heater operation

Features are: (1) Safety: Indirect method of heating keeps inflammable fluid farthest from direct flame. Heating is even without excessively high local temperatures. (2) No heater firebox burnouts: The fresh water surrounding the firebox is non-corrosive and does not contain sufficient depositable hardness to cause scale to form on the firebox. (3) No caked-up flow tubes: The low, even water bath temperature minimizes scale or lime deposits. (4) Special built-in submerged choke eliminates choke freezing due to hydrates and allows medium-pressure inexpensive flow tube bundle to be used. (5) Special corrosion-resistant flow tube bundles may be used for handling sulphur-laden, corrosive oil or gas.

Tool for Hose Clamping

A NEW method of clamping hose has been announced with the introduction of the Universal Hose Tool, made by American Machine and Metals, Inc., East Moline, Illinois.

The Universal bends the hose band around the hose, then by turning a small wheel and pushing forward, the band is clinched firmly. The manufacturer states that in these three simple operations, hose couplings can be made in a few minutes.

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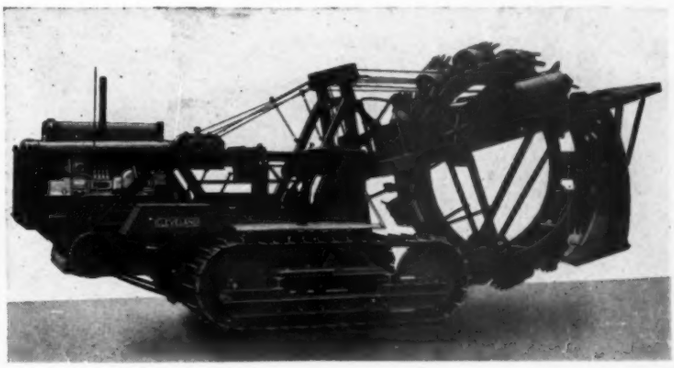

When you buy "Clevelands" you get the most for your money, because they give you BOTH Performance AND Economy.

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ECONOMY—Because the strength and the supreme excellence of their construction means long life and low operating costs.

"Clevelands" . . your best buy . . give you BOTH

THE CLEVELAND TRENCHER COMPANY

20100 ST. CLAIR AVENUE "Pioneer of the Small Trencher" CLEVELAND, OHIO

Acid Mask

COMPLETE head and neck protection for workers handling acid and other dangerous solutions is provided by the Bullard Acid Mask. The shatter-proof laminated goggles fit snugly around the eye cavities so that the hood cannot slip or turn. This feature assures good vision when the head is turned in any position, it is stated.

The live rubber goggle mounting is provided with inbuilt air vents of the indirect type that prevent splattering liquids from entering, yet keep lenses from fogging under normal working conditions.

Form-fitting shoulders offer full neck and chest protection. There is ample impregnated cloth in the Bullard Acid Mask to tuck into other clothing, so that all vital parts of the body are protected. Seams are double stitched—then rubber cemented to add longer wear. When the hood must be worn for long periods, ask for information on forced air ventilation attachments, as this hood does not provide respiratory protection.

The Acid Mask is manufactured by E. D. Bullard Company, 275 Eighth Street, San Francisco, California.

PREVENTS YOUR
Wire Line
SPOOLING
TROUBLES
Prevents the line from piling up, crawling and overlapping.
Prevents all contact of wire line with drawworks housing.

The Grizzly Wire Line Turn Back is a simple yet ingenious device that saves wire lines and prevents practically all wire line spooling troubles. By turning back the line as it reaches each end of the drum . . . with just enough pressure to make the line track smoothly . . . piling up, crawling and overlapping are prevented. All contact between the wire line and drum flanges of drawworks, sand reels, and other equipment also is prevented; thereby eliminating excessive wear and breakage of cable strands which might cause the line to snap. Supplied with either bolt-on or weld-on type base, with adjustable feature to provide proper tension to make line spool smooth and straight. Ask your supply dealer for details, or write for Bulletin No. 16-OF.

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GRIZZLY
WIRE LINE TURN BACK

Williams' "Superrenches" In Structural Box Pattern

J. H. WILLIAMS AND COMPANY, 225 Lafayette Street, New York City, have recently added a Structural Box Pattern wrench to their line of chrome-molybdenum "Superrenches." The new wrench is designed to bring greater safety to structural work. The

12-point box head insures a firm hold on the nut and the offset handle provides maximum clearance, it is stated. The long tapered handle provides ample strength and leverage and is of the type preferred by steel workers for lining-up bolt holes. These wrenches are available in 6 sizes with openings $1\frac{7}{16}$ to $2\frac{3}{8}$ in., accommodating U. S. Std. Nuts $\frac{7}{8}$ to $1\frac{1}{2}$ in. They are forged from chrome-molybdenum steel, heat-treated, and finished in baked gray enamel overall.

Research Develops Oil-Well Cement That Remains Fluid and Pumpable

OIL MEN have pointed out that for successful cementing, an oil-well cement should remain fluid and pumpable for extended periods under different hole temperatures and pressures. It was to meet this severe requirement, says an announcement by Universal Atlas Cement Company, that Unaflo, the cement with a "retarded" set, was developed six years ago and that has been constantly improved by research in the field, laboratory, and plant.

"Normal Portland cement," continues the announcement, "begins to stiffen when water is added, continues to stiffen thereafter, and does so at a much faster rate when temperature increases. Slow-setting cement stiffens similarly but at a slower rate. In contrast with this characteristic, Unaflo cement has a delayed—a postponed—a 'retarded' set. Thus it does not congeal but remains fluid and pumpable for

the entire period of retardation, after which it hardens normally. It does not stiffen or jell, but remains fluid under different hole temperatures and pressures all during the period required for pumping, including unforeseen delays and shutdowns for extended periods."

As a result of its "retarded" set, continues the announcement, this type of oil-well cement:

1. Permits placement of slurry while still fluid;
2. Remains fluid and pumpable after period of rest;
3. Minimizes the hazard of sticking the pipe;
4. Provides a safe cement for various cementing operations, including deep, tough jobs.

According to the announcement, the introduction of an oil-well cement with the distinctive feature of a "retarded" set brought about several important improvements in cementing. With cements that begin to stiffen when water is added and that stiffens more rapidly as the temperature increases, light, 13-lb. slurries often were used to maintain pumpability. When Unaflo, the cement with a "retarded" set, became available, practice shifted to the heavier and stronger 16- and 17-lb. slurries, it is stated. These have several distinct advantages, according to the announcement, as a heavy slurry that does not stiffen or congeal but remains fluid and pumpable for extended periods:

1. Behaves like a good rotary mud in following irregularities of well bore and casing couplings;
2. Flushes ahead of it the lighter, rotary mud without breaking the mud seal
3. Does not become contaminated with the mud;
4. Produces back of the casing a more continuous body of good cement;
5. Results in a stronger, denser, more impervious seal.

"Despite the satisfaction that Unaflo 'retarded' cement gave upon its introduction six years ago, and the 2100 percent increase in its use since then," continues the announcement, "the Universal Atlas Cement Company was not satisfied. Its research engineers continued their studies in the laboratory, in the plant, and in the field. As a result of this continuing research the product has been further improved to provide more uniform field performance and an even better safeguard for all kinds of cementing and recementing jobs."

The announcement concludes by listing the following as features of improved Unaflo:

CHARACTERISTICS

Composition is more uniform;

Reaction to different mixing waters found on different jobs is more uniform;

Retardation of setting time under different temperatures is more uniform;

Stiffening of slurry is not merely "slow." It is delayed, postponed, "retarded." It remains fluid and pumpable for period of retardation, then hardens normally.

ADVANTAGES

Less mixing water is required for sustained pumpability;

Stronger, denser, more impermeable seal is obtained with heavier slurry;

Fluidity is maintained under different hole temperatures and pressures;

Pumpability is maintained after shutdowns for extended periods.

RESULTS

Cementing economy is obtained by overcoming unpredictable hazards;

Protection is greater for costly investment already made in tools, equipment, and well;

Insurance is increased against loss in cases of unforeseen accidents;

Factor of safety is higher.

OF COURSE, a crop of foliage like that takes years of careful cultivation. And maybe J-M 420 Lining wouldn't last quite so long. But this tough, durable lining does have a well-established reputation for long life on drilling rigs.

On the job, it lives up to its reputation so well that most manufacturers of drilling equipment use it for original equipment . . . more and more operators are standardizing on it for replacements. Try J-M 420 on your own rigs. ***Watch it improve feed-off and load-control, step up braking efficiency, cut down on rim scoring.***

• • •

For complete information on the many advantages of J-M 420 Rotary Lining, write for brochure FM-10A. Address Johns-Manville, 22 East 40th Street, New York, N. Y.

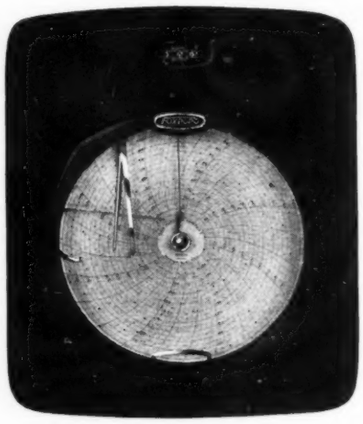
Johns-Manville 420 ROTARY LINING

Foxboro Announces New Model 30 Stabilog Controller

WHEN The Foxboro Company introduced the Stabilog Controller, it was presented as the first instrument providing full proportional control with automatic reset of the control point. Many thousands of installations have since been made, in applications involving control of temperature, pressure, liquid level, or flow; and it is an impressive fact that in more than ten years of this field experience, no changes have been found necessary in the fundamental principles of operation. In introducing the new Model 30 Stabilog Controller, now, Foxboro emphasizes the fact that the new features are principally refinements, for better appearance and still closer control, but that the Model 30 does not depart from the tested and proved Stabilog Control principles.

The Model 30 appears in the new universal rectangular case, which combines practical convenience with attractive appearance. When panel-mounted, the instrument extends only ¾ in. from the panel surface. The door is recessed; hinges and hasp are flush with the door surface. A dual pressure indication, replacing the customary two small gauges, is easily seen through a rectangular opening in the door. Interior illumination is readily provided when desired.

All operating adjustments are made from the front of the case, the adjusting mechanisms for change of control point, throttling range, and reset resistance being immediately accessible when the door is opened. But the entire operating mechanism is protected and



concealed behind a removable plate. Unit construction simplifies replacement of the measuring system, changing the type of control, or any other major servicing of the mechanism that may ever be necessary.

Operating features of the new Stabilog Controller are described in connection with the instrument's three functions: The first is its proportional function, providing uniform pneumatic proportional action, adjusted to the smallest value that will result in stabilization following a disturbance of process conditions. The reset function, the secondary adjustable controlling function, acts simultaneously with the proportional function, establishing stabilization at the desired point of control. The third function provides a temporary additional correction, determined by the rate of change in any disturbance of conditions. If the rate of change is fast the additional correction is large; if the rate of change is slow the additional correction is negligible. The operation of this third function is entirely automatic, being governed by the proportional and reset adjustments.

Recording and Indicating Model 30 Controllers are illustrated and described in Bulletin A-252, which will be sent on request. Address The Foxboro Company, Foxboro, Massachusetts.

Time Cycle Regulators

FISHER Governor Company, Marshalltown, Iowa, has announced a new series of Time Cycle Regulators for cycle control on gas-lift systems. Low gas-oil ratios, increased production, and low operating costs are a few of the results obtained with this pro-

In Los Angeles - all this for $5 a day

Luxurious Apartment for two, with kitchenette, breakfast nook . . . daily maid service, 24-hour switchboard service, and all the comforts of home, with —

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duction method, the manufacturer asserts. The new Fisher "B" series of intermitters has several outstanding features, it is stated.

The intermitter pilot assembly incorporates a new universal cam assembly consisting of 2 chromium-plated clock wheels, each provided with a set of 8 lugs. The lugs are easily set to obtain any desired timing intervals; individual intervals may be readily changed; or all intervals may be lengthened or shortened simultaneously by simply rotating one of the wheels with relationship to the other. Thus complete flexibility in timing of desired on and off periods is readily available.

In addition to increased flexibility, the Series "B" cam assembly offers added dependability and longer life because of greater strength in construction and design, the makers state. Clocks are finest instrument type construction—absolutely dependable, it is said. All pilot parts are fully protected by the weatherproof, gas-tight case with gasket sealed hinged cover. The entire unit is particularly designed for severe operating conditions such as are encountered on outdoor installations.

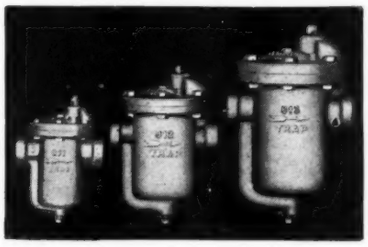
Another feature of these new Fisher intermitters is the integral mounting of the auxiliary operating medium regulator and filter. The controller is shipped completely assembled with all copper tubing connections made. (See illustration.) This feature greatly simplifies installations in the field. When desired the intermitter can be supplied with the regulator and filter unmounted, but connected to the pilot case with iron pipe. Diaphragm valves are standard Fisher construction, either push down to open or push down to close. They are particularly designed for pilot controls.

Fisher Bulletin 80D, just off the press, gives full details and specifications.

Armstrong Extends Line of "Side Inlet" Steam Traps

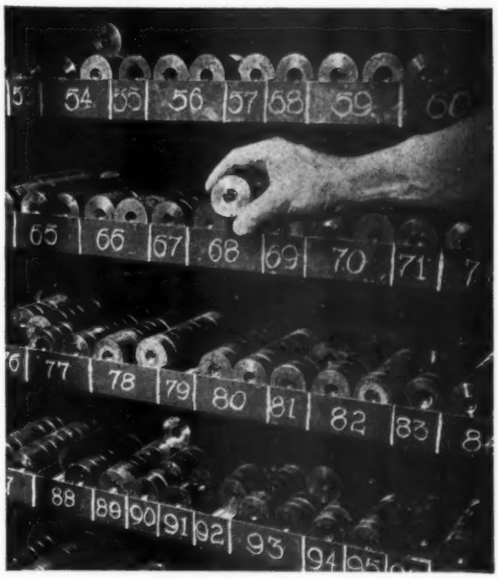
EXTENSION of its standard line of "side inlet" type steam traps with the addition of three new sizes is announced by Armstrong Machine Works, Three Rivers, Michigan. As shown in the accompanying illustration, they are designated as No. 811, 812, and 813.

No. 811 is in the 800 to 1000 lb. per hour capacity range; No. 812 from 1600 to 2000 lb. capacity, and No. 813 from 3000 to 4000 lb. per hour capacity.



All three traps are constructed on the same basic design, used for a number of years for Armstrong side-inlet traps—the design that was introduced by Armstrong in 1930 as the No. 100 trap, a straight-through horizontal-connection inverted bucket trap.

The new traps are built for operation on pressures to 250 lb. gauge. All are available with blast-type thermic air vent buckets for fast air removal and faster heating; and can be equipped with internal-type check valves as optional extra equipment.



YES, a "JEWELRY SHOP" in a WIRE ROPE Plant!

The die-racks are the "jewelry counters" in the Union Wire Rope plant — and as much care is given these dies as a jeweler devotes to fine diamonds. For these dies insure rigid uniformity — one of the characteristics that have made Union Wire Ropes the standard of quality!

8

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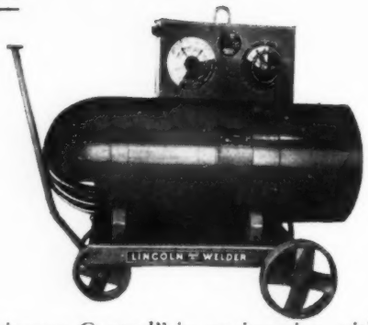
UNION Wire Ropes
The "ULTIMATE LOW COST WIRE ROPE"

Improved Lincoln Arc-Welder Control



IMPROVED and simplified design of its exclusive system of "Dual Continuous Control" for arc-welding machines that eliminates the need for meters showing volts and amperes is announced by The Lincoln Electric Company, Cleveland, Ohio.

This new welding facility has been in engineering design development and preliminary production line-up for some time and is said to be achieved as a result of the accuracy possible in current adjustments with "Dual Continuous Control" in conjunction with Lincoln's self-indicating pre-set dials.

These welders have both job selector and current control calibrated and equipped with dials that indicate the type of work and the number of amperes for each and every setting. It is asserted that this feature enables the welding operator to obtain highest quality welds and highest possible welding speeds because he can vary both the slope of the volt-ampere curve and the amount of welding current independently and positively to suit every job.

Another feature of this welder control is that both voltage control (job selector) and current control are continuous in operation. This design provides literally thousands of possible combinations of voltage and current. It is stated that this simplifies the setting of the control and accounts for an exceptionally wide welding range as to types of work, welding conditions, sizes of electrodes, and thicknesses of material.

Being continuous, the control can be advanced or retarded in increments as fine as desired.

In addition to simplifying arc-welding machine operation by eliminating the necessity on the part of the operator of referring to a meter to check volts and amperes, this advance in arc-welder design permits a price reduction of $20, according to the manufacturer.

An important advantage made available by this design development is the ability to positively reverse polarity. The location of the reversing switch has been changed to the position formerly occupied by the meter, immediately above and between the self-indicating dials. Settings of the reversing switch for "off," "electrode negative" and "electrode positive" are indicated by markings on a disk attached to the control box.

Advantages of the new development, as emphasized by the manufacturer, include (1), ability to set and read the current from the dial; (2), elimination of trouble and expense resulting from meter breakage; (3), elimination of meter inaccuracy after a few months use in service in the field; (4), availability of positive polarity reversal; and, (5), ability to quickly verify polarity by noting position of switch handle.

Indicating Lamp

FOR general indicating or signal purposes on switchboards, control desks, and panel boards, a new indicating lamp is announced by Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa.

Known as the Minalite, the lamp has a rectangular-shaped lens designed for extreme angular visibility. Receptacle is made of one-piece moulded material and is suitable for mounting on panels $\frac{1}{16}$ to 2 in. thick. Resistors as part of the unit are used for line voltage ratings between 50 and 250 volts.

Tulsa Boiler & Machinery Co.

WEST TWENTY-FIRST STREET & UNION AVENUE TULSA, OKLAHOMA

Jackson Heads New Lane-Wells Office at Dallas

Lane-Wells Company recently opened an office at 714 Gulf States Building, Dallas, Texas, under the supervision of Warren J. Jackson. The new branch office will permit a closer tie-in between the Shreveport and Odessa districts and will provide better sales and service contacts with its many customers in Dallas and Fort Worth. The office will also facilitate communication between the Mid-Continent and Gulf Coast divisions.

WARREN J. JACKSON

Jackson joined the Lane-Wells organization March 10, 1941, being first assigned to the post of district sales engineer in the Houston district. In this capacity it was possible to augment his knowledge of those production practices involving Lane-Wells services with special emphasis on direct application and sale of these services.

Jackson obtained degrees in geology and petroleum engineering from Louisiana State University and is a registered professional engineer in the State of Texas. His 16 years' close association with petroleum production engineering problems has included roustabouting, roughnecking, oil production, and refinery work in various felds of North Louisiana, Arkansas, West and West Central Texas, and on the Louisiana-Texas Gulf Coasts. During this time Jackson specialized in gas conservation, particularly those practices involving gas-lifting, repressuring, and pressure maintenance.

While in the employ of the Humble Oil and Refining Company, Jackson had an opportunity to use gun-perforating quite extensively in the selective completion of wells; and as a result of this knowledge he was impressed by the contribution Lane-Wells was making to the solution of gas conservation and oil production problems. Other applications of gun-perforating being made under Jackson's supervision include selective gas injection for repressuring and pressure maintenance operations.

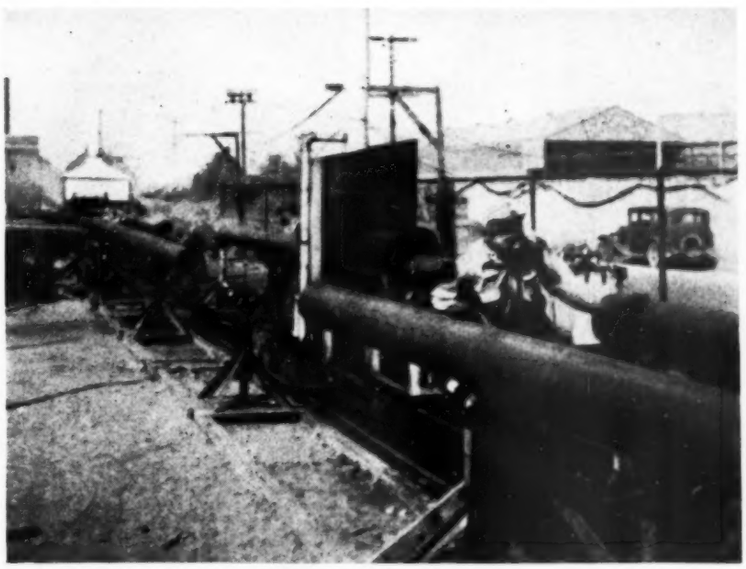
In a recent interview Jackson indicated that he is a firm believer in the principle that to do a good job as a sales engineer in the oil industry today, particularly in our country's present state of emergency, it is essential that the sales engineer associate himself more closely with the operator's immediate and future problems so that he may assist in helping his customer do a better and more economical job with the tools now available. Constant improvement of existing equipment is reflected in improved services to oil-well operators. These technical improvements will enable operators to compete in the future against foreign inroads in the international market.

Louisiana Engineering Society to Meet

The 1942 Annual Meeting of the Louisiana Engineering Society will be held at the St. Charles Hotel, New Orleans, on January 9 and 10, 1942.

An interesting program has been arranged.

Longer Life of Service Assured



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John Fritz Medal Awarded to E. L. DeGolyer

Everette Lee DeGolyer, consulting petroleum engineer of Dallas, Texas, and Deputy for Conservation under the the Federal Petroleum Coördinator for National Defense, has been awarded the John Fritz Medal for 1942. Sponsored by the four Founder American Engineering Societies, the medal is generally recognized as the greatest distinction in the gift of the engineering profession. The award to Dr. DeGolyer is made in recognition of his pioneer work in the application of geophysical exploration to the search for oil fields. It is estimated that the discovery of 3,000,000,000 bbl. of oil, in the United States alone, can be attributed to this technique.

According to announcement made by A. B. Parsons, secretary of the American Institute of Mining and Metallurgical Engineers, the presentation of the medal will be made under the auspices of that institute at a dinner to be held in New York City at the Waldorf-Astoria on Wednesday, January 14, 1942. Dr. DeGolyer is a past-president of the American Institute of Mining and Metallurgical Engineers.

Former recipients of the John Fritz Medal include George Westinghouse, Thomas A. Edison, George W. Goethals, Orville Wright, Guglielmo Marconi, Herbert Hoover, and Daniel C. Jackling. The Board of Award consists of four past-presidents of each of the following societies: American Society of Civil Engineers, American Society of Mechanical Engineers, American Institute of Electrical Engineers, and the American Institute of Mining and Metallurgical Engineers.

Dr. DeGolyer, a native of Kansas, graduated from the University of Oklahoma in 1911. After serving for

E. L. DeGOLYER

a few years on the U. S. Geological Survey, he entered the petroleum industry and has been engaged in it ever since. He was the first engineer to recognize the importance of geophysical methods of prospecting for oil; and he has been a leader in developing and applying new methods since 1914. Through these methods vast areas have been explored that were not susceptible to successful exploration by the study of surface geology. He organized and was for many years chairman of the board of the Amerada Corporation. He is now a member of the firm of DeGolyer-MacNaughton and McGhee, consulting petroleum engineers of Dallas, Texas. In 1940, he was awarded the Anthony F. Lucas Gold Medal by the American Institute of Mining and Metallurgical Engineers in recognition of the same outstanding achievements in the petroleum industry for which he now receives the John Fritz Medal.

T. I. Phillips Elected Vice-President of Westinghouse

Election of T. I. Phillips as a vice-president of the Westinghouse Electric and Manufacturing Company was announced after a recent board meeting by A. W. Robertson, chairman. Phillips entered the employ of the company as a tool maker in 1915 and has been assistant to the president of the company since February 14 of this year.

Where SLIP is an advantage . . .
The Twin Disc Torque Converter's characteristic "slip" is a distinct advantage to the driller because it provides a safety factor. With the table rotating, it prevents the drill pipe from snapping off with a sudden shock load. Varying loads at the drill pipe are met immediately by the converter's automatic torque-speed adjustment . . . another reason why drillers say that a Twin Disc Torque Converter gives an internal combustion engine the desirable characteristics of steam performance. TWIN DISC CLUTCH COMPANY, 1329 Racine Street, Racine, Wis.
ILLUSTRATED: Hydraulic Torque Converter.
TWIN DISC
CLUTCHES AND HYDRAULIC DRIVES
REG. U. S. PAT. OFF.

One Method of Constructing Salt Water Pits in East Texas Field

by H. Lee Flood
Associate Editor

PETROLEUM ENGINEER Exclusive Feature

SALT water disposal in the East Texas field is becoming increasingly important. Whether or not injection wells are employed in the disposal program, many companies find it necessary to construct open pits to provide for evaporation, settling, or both. The accompanying photographs show briefly the methods employed by one company operating in East Texas in the construction of salt water pits.

The first step is to select a site for the pit in which preferably the cut and fill will balance. Another objective is to obtain a site in which clay will be encountered at the required depth so that the floor of the pit will have a satisfactory foundation. The greater part of the excavation is made with mechanized equipment, including a dragline. Loose earth in the dike is compacted by means of a sheeps-foot roller. Fig. 1 shows a pit after the earth work has been completed. The pit shown has a capacity of 3000 bbl. The base of the pit is a 41-ft. by 41-ft. square. The sides of the pit have a slope ratio of 2 to 1; consequently, the pit at the rim is a 65-ft. by 65-ft. square.

Prior to lining the pit with concrete the concrete beams or "sleepers" are installed on the bottom and sides of the pit as shown in Fig. 1. These beams are approximately 12 in. wide, 3 to 4 in. deep, and are reinforced with 3-in. by 3-in. 10-ga. black iron mesh. To assist in the curing process these beams are usually covered with wetted burlap.

Fig. 1. Concrete beams are installed prior to applying the cement by guniting

The next step in the construction is to apply a ¼-in. coating of No. 37 or 39 asphalt to the sleepers.

The entire surface of the pit is then covered with 3-in. by 3-in. mesh as reinforcement for the concrete, which is applied by the pressure method commonly known as guniting. Screeds are then installed over each sleeper to provide expansion joints in the concrete. The general objective in the spacing of the beams (and expansion joints) is to have no more than a 20-ft. continuous length of gunited concrete.

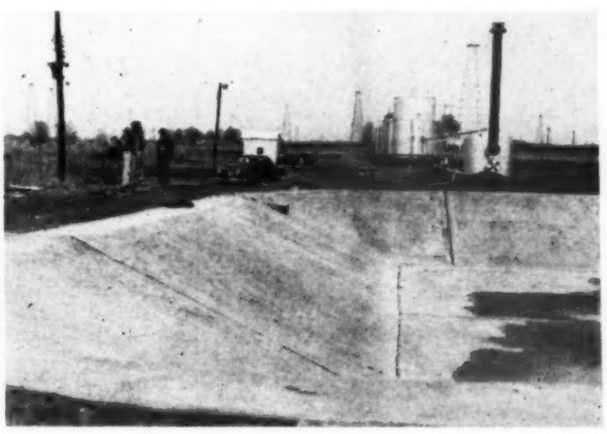
The methods of applying the concrete follow the conventional methods of guniting. The cement and aggregate (a coarse sand) are mixed dry in an ordinary concrete mixer. The dry material is then introduced into the hopper of the gunite mixer in which water under pressure is introduced. The resulting slurry flows from the hopper to the point of application through long flexible hoses. Concrete is built-up to a thickness of 2 in. on the bottom and sides of the pit.

After the guniting operation has been completed, the screeds are removed and the joints filled with asphalt. At one side of the pit a 2-compartment settling sump is provided for skimming purposes. One of these sumps is shown in Fig. 2.

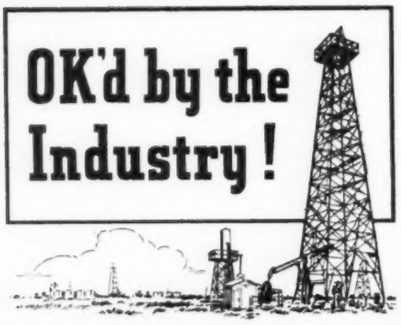
——☆☆☆——

Fig. 2. Two-compartment skimming sump

Fig. 3. A portion of the completed pit

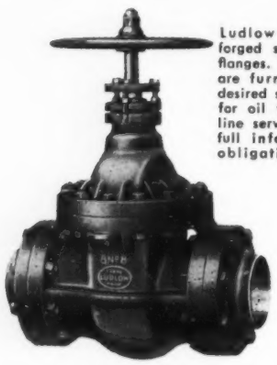


OK'd by the Industry!



Hundreds of oil field and pipe line installations prove that Ludlow Valves are OK'd by the industry. And every year finds many more Ludlow Valves going into service.

Study the four points in the panel below. They explain the principle of valve construction that Ludlow developed and perfected — they point out the definite benefits that Ludlow Valves offer. Don't take a chance — specify Ludlow for longer life and trouble-free performance.



Ludlow Valve with forged steel welding flanges. Ludlow Valves are furnished in any desired sizes and types for oil field and pipe line service. Write for full information—no obligation, of course.

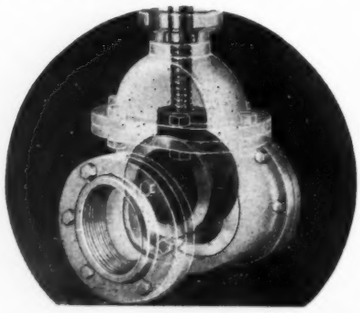
LUDLOW PARALLEL SEAT DOUBLE GATE VALVES

Smooth, positive operation. Gates positioned directly opposite ports before wedging and entirely unwedged before being raised.

Positive closure—even after years of service in the open position. 30° wedges. Gates self-adjusting to seats.

Self-cleaning. Seat rings cleaned throughout entire stroke. No internal guides to cause foul-up.

Ready replacement of parts. Simple construction to ample tolerances.

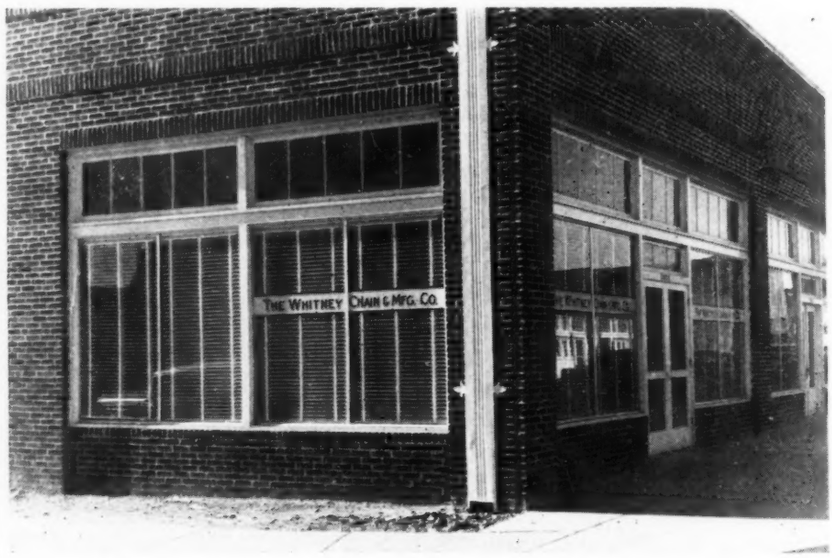


The LUDLOW VALVE MFG·CO·INC· SINCE 1866 TROY·N·Y·

Whitney Chain Opens Dallas Warehouse

The Whitney Chain and Manufacturing Company, Hartford, Connecticut, has announced the opening of a new Dallas warehouse at 2826 Elm Street under the direction of J. W. Anderson, direct factory representative for the Mid-Continent area.

The Dallas warehouse carries a complete stock of Whitney roller and silent chains and couplings and combines the services of their previous factory warehouses at 224 East Third Street, Tulsa, Oklahoma, and 4411 Navigation Boulevard, Houston, Texas. Sales and engineering services will be continued from these points as in the past.



Dallas warehouse of Whitney Chain and Manufacturing Company

San Joaquin Chapter A.P.I. Elects

The year's last meeting of the San Joaquin Valley Chapter of American Petroleum Institute was held at the Standard 11-C meeting hall, Taft, California. Officers for 1942 were chosen. Those elected are J. B. Wharton of Belridge Oil Company, chairman; George O. Suman of Tide Water Associated Oil Company, vice-chairman in charge of programs, and C. Hall Montgomery, vice-chairman responsible for membership. The ten new advisory comitteemen chosen are Hugh S. Allen of Kern County Land Company; W. F. Barbat, O. A. Cavins, and K. C. Hayes of Standard Oil Company; W. A. Clark and H. C. Stone of The Texas Company; P. H. Lehr of Shell Oil Company, Inc.; D. K. McLennan of Fellows; J. J. O'Keeffe of Richfield Oil Corporation, and T. H. Wallace of Western Gulf Oil Company.

The resignation of W. T. Woodward, secretary-treasurer for the last three years, was followed by his appointment to the advisory committee to replace Claude E. Peavy, resigned. Melvin L. Barlow, instructor in petroleum technology at the Taft Junior College was named the new secretary-treasurer.

In addition to the above-named officers, the executive board is composed of E. P. Campbell, R. R. Shinn, J. J. Wilt, P. C. McConnell, H. G. Barton, J. B. Stevens, R. L. Keyes, H. S. Stark, Lot Bowen, E. H. Musser, J. B. Wells, J. R. Thomas, Elmo Fullmer, K. E. Grigsby, D. E. Koch, J. C. Ractor, R. E. Sallady, A. L. Tietze, W. J. Schultz, A. F. Turman, and Fred E. Smith.

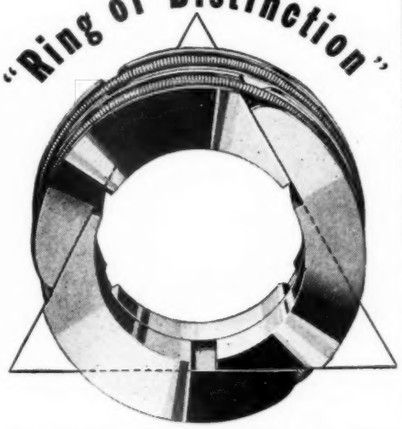
Stewards for the years just closed were C. B. Williams and R. S. Bruce; technicians, R. W. Fowler and E. B. Adams.

Following the election, the members and guests enjoyed a program that included a paper on "Field Application of Core Analysis and Depth-Pressure Methods to the Determination of Mean Effective Sand Permeability," by N. van Wingen of Richfield Oil Corporation, Taft; an informal talk on "Pressure-Volume-Temperature Relations," by C. R. Dodson of Standard Oil Company, LaHabra, and a sound movie produced by Pacific Gas and Electric Company, "Whirling Wheels," arranged through J. R. Minner.

Juan Zunino, geologist with the Argentine Government, was introduced at the meeting by C. Hall Montgomery, vice-chairman elect. Zunino is in this country observing various oil industry practices.

FOR THE DEFENSE OF DEMOCRACY
THE BEST IS NONE TOO GOOD

FRANCE PACKING
has a
"Ring of Distinction"



Imitated but never duplicated, the France ring is manufactured in three sections. The contacting faces form the lines of an equilateral triangle. As the ring is expanded or contracted, the sections must move in or out radially equal distances from the center of the rod to which the ring is fitted.

This fundamental mechanical principle accounts for the efficiency, trouble-free performance and extra-long life of France Metal Packing.

After years of service, when the rings have become worn to such an extent that the sections nearly butt together, further years of additional service can be obtained by cutting off the narrow points of the three sections where they form a part of the inner circumference of the ring. The spring then requires adjustment so that the sections are held to the rod with a slight tension.

For installation in engines, pumps and compressors—under all conditions of service, France Full-floating Metal Packing means true economy in the long run.

Permit France Engineers to analyze your packing requirements.

Write for Catalog M-3

Sold on approval
Satisfaction Guaranteed

THE FRANCE PACKING COMPANY
Tacony Philadelphia Penna.

Mid-Continent Representative:
MR. J. M. FULLER, 3725 W. Seventh St.
FORT WORTH, TEXAS

Original FRANCE METAL PACKING

Petroleum Industries Association Elects New Officers

R. L. Peurifoy, dean of the engineering department of Texas A. & I. College at Kingsville, was elected president of the Petroleum Industries Association recently, at the first fall meeting of the organization at Alice.

George L. Noble, Jr., district manager of priorities for the Office of Production Management at Houston, Texas, discussed the question of priorities for the gathering of more than 100 South Texas members of the petroleum and gas industry and other allied petroleum workers.

Other officers elected were: J. A. Huff, Alice, first vice-president; Ed Breedlove of Alice, second vice-president; Frank H. Dotterweich of Texas A. & I., Kingsville, third vice-president; J. W. Rockwell, fourth vice-president; Ted Brammer of Robstown, secretary-treasurer; and directors: M. M. Miller of Alice, Knox Miller of San Antonio, Frank Bridwell of Alice, Harold Decker of Corpus Christi, H. P. Kemp of Alice, E. E. DeBack of Corpus Christi, J. W. Gorman of Freer, Chas. Bryant of Corpus Christi, R. D. Shinkle of Alice, T. C. Shaw of Woodsboro, and Pat Downing of Alice.

Retiring officers include J. V. Polk, Woodsboro, vice-president; J. A. Huff of Alice, M. G. Spencer of Victoria, directors.

The association meets once each month to discuss various problems of the petroleum industry in South Texas and to exchange ideas on various phases of the technical processes involved in that industry.

Vinson Supply Opens Amarillo Office

Vinson Supply Company, Tulsa, Oklahoma, has announced the opening of its new branch office in the Rule Building, Amarillo, Texas. This expansion will enable the Vinson Supply Company to better serve the Texas Panhandle territory.

The Amarillo office is in charge of W. Dow Perry, who for the last several years has been in charge of this area for the Joseph A. Coy Company. The opening of the newest Vinson branch brings to four the number of offices maintained by the company in Oklahoma and Texas. The others are in Dallas, Odessa, and Tulsa. Manufacturers represented include Fisher Governor Company, Chase Brass and Copper Company, Tube-Turns, Inc., and National Tube Company. Stocks are maintained in Tulsa and Odessa.

The DUAL RESPONSIBILITY of SAND-BANUM

ELIMINATES OLD
and
PREVENTS NEW
Boiler Scale and Corrosion
without harm to
Equipment or Personnel

That's the Record—the Proof is yours for the asking.

"The Entirely Different Boiler and Engine Treatment"

SAND-BANUM comes in the handy 16-oz. can that so readily goes from job to job. Use ounces only once each week. One can protects one 250-h.p. boiler for one month.

OUR PRODUCTS Described in the COMPOSITE CATALOG

AMERICAN SAND-BANUM COMPANY, Inc.

9 Rockefeller Plaza
New York City

Stocks carried by
WESTERN SAND-BANUM COMPANY
Houston, Texas Fresno, California
and at other convenient points including leading supply houses.

•

Export Representatives
PETROLEUM MACHINERY CORP.
30 Rockefeller Plaza New York City

LUFKIN
CHROME CLAD
STEEL TAPES

Tired of trying to use a hard-to-read, old fashioned steel tape with worn off markings? Then now's the time to get your new Lufkin "Anchor"—the tape with the Chrome Clad Line that oilmen everywhere are praising. Its jet black markings are easy to read against the satin chrome surface that won't rust, crack chip or peel. The genuine leather, hand stitched case is pleasing to handle and as sturdy as the line it holds. To really appreciate the "Anchor" you should ask your dealer to let you see it. Write us for free Catalog.

LUFKIN
SAGINAW, MICH. New York City
TAPES—RULES—PRECISION TOOLS

C. J. Coberly Director Consolidated Steel

Clarence J. Coberly, president of Kobe Incorporated, was elected a director of Consolidated Steel Corporation, Ltd., at the recent meeting of its board of directors. Coberly will fill the vacancy caused by the death of Donald G. Henderson.

Coberly, long prominent in the engineering field, is well known to members of the petroleum industry. He was graduated from Stanford University in 1915, and for three years was engaged in oil-well tool manufacturing. Early in 1918, he became identified with the California Compressed Gas Company in charge of engineering, and it was he who designed and perfected the well known "Purox" equipment. With the development of the Signal Hill, Santa Fe Springs, Torrance, and Baldwin Hills oil fields, Coberly recognized the need for a scientifically engineered well screen. His research along this line resulted in the invention of the Kobe Process and pipe slotting equipment, now covered by more than 40 U. S. and foreign patents. Kobe Incorporated was formed in September, 1923, and the company derived its name from the nickname by which Coberly has always been known.

C. J. COBERLY

Coberly has also developed the Kobe Hydraulic Oil Well Pump, which operates successfully from depths as great as 9750 ft.

Valve and Meter Representatives Meet in San Francisco

Following the official sessions of the American Petroleum Institute, held in San Francisco recently, more than a score of officials and representatives of Merco Nordstrom Valve Company and Pittsburgh Equitable Meter Company met for the discussion of 1942 activities. They reported from various parts of the country. Colonel W. F. Rockwell discussed policies of the two companies and conditions confronting the organization, priority situations, and plans for immediate expansion. Studies of production facilities were made at the Oakland plant of the companies.

In the accompanying photograph: First row: H. Boezinger, vice-president in charge of west coast sales; Colonel W. F. Rockwell, president, and Captain A. E. Higgins, vice-president and general sales manager.

Second row: Orville Cochran, Kansas City; Jack Siedentopf, Pittsburgh; Hank Gottwald, New York City; George Scherer, director of research, Oakland; Arthur Kerr, vice-president in charge of Mid-Continent sales, Tulsa; Charlie Bergman, San Francisco; Dick Ford, San Francisco, and Jack Cottrell, Tulsa.

Third row: Ernie Adams, Los Angeles; Carl Madison, Houston; Russ Waters, Oakland; Ralph Marriott, St. Louis; Bill McLaughlin, Dallas; Gilbert Bowman, Oakland; Ed Hedene, chief engineer, Oakland; Pete Maxfield, Los Angeles; Andy Fomilyant, Los Angeles; Paul Kreuch, Chicago, and Fred Webster, San Francisco.

START '42
with this
GOOD
RESOLUTION

Resolved:

. . . that all equipment purchased during 1942 must be of a quality which will not require replacement during the national emergency.

It pays to keep a good resolution at any cost. But—when you standardize on CHIKSAN *All-Steel* Rotary Hose, it actually pays you in dollars and cents!

A comparison of costs between Chiksan and other types of rotary hose shows you can actually profit from this good resolution. Start the New Year right by standardizing on CHIKSAN *All-Steel* Rotary Hose.

◆

4" and 5" Sizes
for Drilling
3" for Standby and
Pressure Service

SPECIAL LENGTHS
TO ORDER

◆

GULF ENGINEERS, INC.
Distributors in Texas, Louisiana, Arkansas, and New Mexico

WELL EQUIPMENT CO.
Distributors in Oklahoma and Kansas

CHIKSAN TOOL COMPANY
BALL BEARING SWING JOINTS for ALL PURPOSES
BREA, CALIFORNIA

ALL-STEEL ROTARY HOSE
CIRCULATING HEADS · MUD GUNS
THREE-WAY DISC BIT
STANDARD and HEAVY DUTY REAMERS

W. P. Gage Made Vice-President Shell Chemical Company

W. P. Gage, 32-year-old manager of Shell Oil Company's development division, has been appointed vice-president in charge of manufacturing and technical development for the Shell Chemical Company, according to an announcement just made by the latter company.

In his new position he will be located in San Francisco, headquarters for the Shell Chemical Company, and will be primarily concerned with improvements and additions to plant facilities for the production of chemical by-products of petroleum.

J. C. Gordon Joins Dallas Bank

J. C. Gordon became petroleum engineer with the First National Bank at Dallas, Texas, December 1, succeeding Roy N. McBride, now oil appraisal engineer for the bank.

Prior to becoming petroleum engineer with the bank, Gordon had been

J. C. GORDON

general superintendent for the Illinois Oil Company at Kermit, Texas.

A mechanical engineer graduate, Gordon was employed with Chestnutt and Smith Company as the beginning of his wide and varied experience in the petroleum and gas and related industries.

He was employed by the Pure Oil Company and sent to Mexia, Texas, in 1923 as mechanical and gas engineer. In 1931, he became a design engineer with Black, Sivalls, and Bryson.

In 1933 he was sent to Venezuela by the Standard Oil Company of New Jersey. During his 6 years of work in the tropics, Gordon was employed as petroleum engineer with two affiliated companies of Standard.

RESULTS *Count*

B and W, Inc.

WALL CLEANING GUIDES

Have been used for cementing casing in these fields:

TEXAS GULF COAST

Withers	Anahuac
Vanderbilt	Amelia
West Ranch	Segno
Lolita	Galveston Bay
LaWard	Lovell's Lake
North Markham	Clodine
Katy	League City
Bessie Heights	Dickinson
Fairbanks	West Columbia
Magnet	Maubro
Tomball	North Thompson

LOUISIANA GULF COAST

North Crowley	Chalkley
Gueydan	Iowa
Porte Barre	Erath
Ville Platte	Saint Gabriel
Hackberry	Jennings

SOUTHWEST TEXAS

Sullivan City	Greta
McFaddin	Colorado
Fagan	Placedo
Keeran Ranch	Plymouth
Midway	Minnie Boch
North Clara Driscoll	Freer
Hoffman	Boyle
Flour Bluff	

OTHER TEXAS FIELDS

East Texas Field	Crane
Chapel Hill	Denver City
K.M.A.	Aspermont
Slaughter Pool	

And 37 other Texas fields in which only one company is operating.

WEST COAST

West Montebello	Kettleman Hills
Rosecrans	Rincon
Rio Bravo	Midway Sunset
Dominguez	Wilmington
Ventura Ave.	L. B. Harbor
Signal Hill	Santa Maria
Del Valle	Coalinga N. E.
Huntington Beach	Coyote Hills

. . . and others

OTHER FIELDS

ILLINOIS:	INDIANA:
Roland	Griffin
Brownsville	MISSISSIPPI:
Dale	Tinsley
Albion	

This wide usage PROVES the successful performance of B and W Guides in removing mud cake, centering casing, prevention of channeling and increasing percentage of successful completions.

SEND FOR BULLETIN 102

BRUCE BARKIS — B and W, Inc. — KENNETH WRIGHT

Well Completion Specialists

Makers of
B and W Wall Cleaning Guides
Gulf Coast & Foreign Distributors of
NELSON Pre-Packed Gravel LINERS
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GULF COAST
1105 COMMERCE BUILDING
HOUSTON, TEXAS
TELEPHONE: PRESTON 9783

Look for the Arm and Hammer

ARMSTRONG BROS.

STUB END WRENCHES

These extra heavy, ruggedly designed Chrome Vanadium Steel Wrenches take long tubular slip-over handles, stand up to long leverage . . . tighten screws, bolts and nuts far tighter or loosen them even when badly corroded. These are ideal wrenches around rigs, pipe lines and for general heavy duty work. Three types (from 1¼" to 3½") with long hollow tubular steel handles, each of which fits several sizes.

ARMSTRONG BROS. TOOL CO.
"The Tool Holder People"
331 N. Francisco Ave., Chicago, U. S. A.

WALK IN SAFETY
over nails, spikes, jagged metals

Lost time injuries due to foot puncture wounds are banished along with costly compensation claims, with Bullard Protective Insoles. Two layers of a new rugged flexible plastic give positive protection. Glove-fitting woven cover gives cushion-comfort inside boots or shoes. Non-absorbent and completely flexible; weighs but 2 oz. Sizes 6-11.

NEW FOOT COMFORT

New materials of flexible plastic, with woven "cushion" cover adds comfort to protection.

Ask for prices and descriptive leaflet. ☆ E. D. BULLARD Co., 275 Eighth St., San Francisco, Calif. B-9

Protection with comfort! So flexible, the sole can be rolled in a circle! Weight, 2 oz.!

Everything BULLARD in Safety

BULLARD Protective INSOLES

First Annual Drilling Contractors Meeting a Success

The American Association of Oilwell Drilling Contractors' first annual meeting, held in Dallas, November 13 and 14, was so successful that officers and directors are already planning an expanded program for 1942. Attendance was about 300, remarkably high for a first meeting, and intense interest was shown in both committee meetings and general sessions. Every major producing district in the United States was represented. A bound volume containing a full report of the meeting will be sent soon to all members.

Officers elected for 1942 are:

President, J. E. Brantly, Los Angeles, California.

Assistant to president, W. D. McBee, Dallas, Texas.

Vice-president at large, Harry L. Edwards, Houston, Texas.

Vice-president for cable tools, Ben M. McGraw, Crossville, Illinois.

Treasurer, C. J. Paine, Dallas.

Executive secretary, Brad Mills, Dallas.

The number of directors in each region has been increased to three, and the number of directors at large to 25. Directors selected are:

Directors carrying over whose terms expire in 1942—Pacific Coast: Walter Buaas, Bakersfield, California. Permian Basin: C. J. Davidson, Fort Worth, Texas. North Central Texas: J. J. Moran, Wichita Falls, Texas. Central Mid-Continent Basin: A. S. Ritchie, Wichita, Kansas. Cretaceous and Tertiary Basins: J. I. Roberts, Shreveport, Louisiana. Gulf Coastal Region: E. B. Rubsamen, San Antonio, Texas. North Central Paleozoic Basin: Walter G. Tschudin, Mt. Vernon, Illinois. Rocky Mountain Region: (no carryover). Ap-

J. E. BRANTLY, *President*

C. J. PAINE, *Treasurer*

HARRY L. EDWARDS
Vice-President at Large

W. D. McBEE
Assistant to President

palachian Region: Wallace E. Haupt, Greensburg, Pennsylvania.

New directors who will serve until 1943—Pacific Coast: Thomas P. Pike, Los Angeles, California. Permian Basin: George Cree, Pampa, Texas, and Ed Warren, Midland, Texas. North Central Texas: Frank Wood, Wichita Falls, Texas. Central Mid-Continent Basin: Glenn Campbell, Tulsa, Oklahoma, and Frank Stickle, Tulsa, Oklahoma. Cretaceous and Tertiary Basins: N. H. Wheless, Shreveport, Louisiana. Gulf Coastal Region: Cecil N. Housh, Houston, Texas, and Horace Fitzpatrick, Corpus Christi, Texas. North Central Paleozoic Basin: Harvey H. Sims, Salem, Illinois, and Ben McGraw, Cronville, Illinois. Rocky Mountain Region: Don Martin, Denver, Colorado. Appalachian Region: John J. Klise, Wooster, Ohio.

Directors-at-large are: Will I. Lewis, Mt. Vernon, Illinois; Leslie Fain, Oklahoma City, Oklahoma; M. J. Delaney, Dallas, Texas; J. E. Brantly, Los Angeles, California; C. J. Paine, Dallas, Texas; Harry L. Edwards, Houston, Texas; Warren S. Churchill, Tulsa, Oklahoma; Howard P. Holmes, Dallas, Texas; Joseph Zeppa, Tyler, Texas; Cyrus Bell, Los Angeles, California; Glenn H. McCarthy, Houston, Texas; Grady H. Vaughn, Dallas, Texas; Al A. Buchanan, San Antonio, Texas; George Livermore, Lubbock, Texas; George F. McQueen, Fort Worth, Texas; A. R. Dillard, Wichita Falls, Texas; George H. Lang, Tulsa, Oklahoma; Lon Cron, Houston, Texas; A. T. McDannald, Houston, Texas, and Louis Franklin, Houston, Texas.

The Executive Committee consists of: J. E. Brantly, Warren S. Churchill, C. J. Davidson, Harry L. Edwards, Ben M. McGraw, A. S. Ritchie, C. J. Paine, and Al Buchanan.

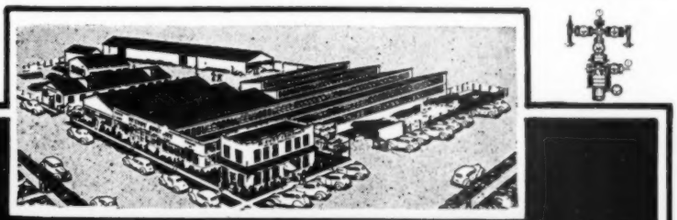
BRAD MILLS
Executive Secretary

Tool Men Meet

The meeting of the Service Tools Industry recently held in Chicago, Illinois, has formed a Coördinating Committee for National Defense to represent the industry before O.P.M. and the Steel Allocation Board.

The committee is headed by Dillion Stevens, vice-president of the Plomb Tool Company. Other members are E. J. Wilcox, J. H. Williams and Company; Roger Palmer, Snap-On Tools Corp.; W. F. Costello, New Britain Machine Co.; A. J. Male, Bonney Forge and Tool Works; W. R. Horsford, Duro Metal Products Co., and Edward Norris, Utica Drop Forge and Tool Corporation.

DILLON STEVENS



McEVOY

COMPANY

"OIL WELL EQUIPMENT" SINCE 1906

TEXAS AT MILBY • HOUSTON, TEXAS • TELEPHONE C-2288

SEE McEVOY'S 20 PAGE SECTION IN YOUR COMPOSITE CATALOG

CHRISTMAS TREES
COUNTER HYDROSTATIC GAS LIFTS
SCREENS
PACKERS • SET SHOES

KEEPING 14,622' MUD COLUMN IN TOP CONDITION

Honolulu Oil Corp.'s recently completed 14,622' hole at Buena Vista Hills, Calif., is the second deepest hole ever drilled. Two Link-Belt 48" x 60" vibrating mud screens were used to properly recondition the drilling mud . . . one as a standby unless circulation volume required dual screen operation. The world over you'll find Link-Belt screens keeping drilling mud free of destructive materials . . . keeping the drilling fluid situation well in hand.

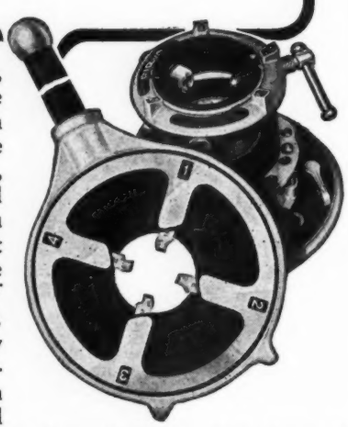
LINK-BELT COMPANY, Philadelphia, Houston, Dallas, Los Angeles, New York, Toronto. Sold by most supply houses.

8646

LINK-BELT MUD SCREEN

Now when speed is so vital

You can set this Work-Saver RIDGID No. 65R to thread 1" 1¼" 1½" or 2" pipe *in 10 seconds!*



SPIN UP workholder, set cam post to pipe size, spin it down—turn workholder cam plate to size—put on the pipe, tighten one screw—and start threading! You won't believe how fast and easy till you have tried it—*a real saver of precious time and effort.* Dependable? This fully tested all-steel and malleable-alloy tool, with drop-forged tool steel cam plates and high speed steel chaser dies, does all you can ask of it—more smooth accurate threads on any pipe in less time than you've ever been able to cut before. Hundreds of thousands in use. Try this RIDGID No. 65 at your Supply House—*today!*

THE RIDGE TOOL COMPANY, ELYRIA, OHIO

RIDGID

***WORK-SAVING* PIPE TOOLS**

TRADE LITERATURE

What to Write For

MASON-NEILAN REGULATOR COMPANY, 1190 Adams Street, Boston, Massachusetts, has just released its new general Catalog No. 41. Copy of the catalog will be sent on request. It contains descriptions of many standard items in the Masoneilan line and includes illustrations and technical data.

KOPPERS COMPANY, Tar and Chemical Division, has published an 8-page folder summarizing all of Koppers' important products, plants, and services. The folder will be sent on receipt of written request. Address Koppers Company, Pittsburgh, Pennsylvania.

THE BROWN INSTRUMENT COMPANY, Philadelphia, Pennsylvania, is releasing a new Catalog No. 8301, entitled "Industrial Control Devices—Products of Minneapolis-Honeywell Regulator Company." This 56-page, large size, two-color catalog is a comprehensive source of information for all interested in learning how production may be increased, costs lowered, and product quality improved through the judicious use of automatic control of industrial processes, it is stated. The company will gladly send a copy free on request.

E. M. SMITH COMPANY, 600-650 South Clarence Street, Los Angeles, California, urges those interested to obtain from supply dealers or write for their bulletin No. 16-OF, describing the new Grizzly Wire-Line Turn Back.

BULLETIN No. 15 published by the National Tube Company, Pittsburgh, Pennsylvania, contains an explanation of the features possessed by National seamless casing and drill pipe. A written request will bring your copy without delay or obligation.

COMPLETE INFORMATION on J-M 420 Rotary Lining is contained in brochure FM-10A, published by Johns-Manville, 22 East 40th Street, New York, New York. Copies of the brochure will be sent on request.

FRANCE PACKING, the packing said by its manufacturer to have a "ring of distinction," is described and illustrated in Catalog M-3. Full description for installation in engines, pumps, and compressors, under all conditions of service, is contained in the catalog. Write The France Packing Company, Tacony, Philadelphia, Pennsylvania, for your copy.

FOR A DETAILED DESCRIPTION and discussion of Foxboro Model 30 Stabilog Controller, write for Bulletin A252. Address The Foxboro Company, 130 Neponset Avenue, Foxboro, Massachusetts.

THE BANTAM BEARINGS CORPORATION, South Bend, Indiana, is releasing Bulletin P-104 containing details on the Quill Bearing. A copy may be obtained by addressing the company.

DATA BOOK No. 1775 describes the "Friction Fighter" roller bearings manufactured by the Link Belt Company, New York, New York. A copy will be sent on request.

A 20-PAGE DESCRIPTIVE BULLETIN, No. 508E, and illustrated catalog No. 701 describe the Louis Allis explosion-proof motors point by point and the Louis Allis induction-type motor, respectively, for every industrial requirement. Copy of the bulletin and catalog may be obtained by addressing The Louis Allis Company, Milwaukee, Wisconsin.

B AND W INC., "Well Completion Specialists" and manufacturers of the B and W wall cleaning guides, announce release of Bulletin 102, describing the use and advantages of the guide. A copy of the bulletin will be sent on request by addressing B and W Inc., 3545 Cedar Avenue, Long Beach, California, or 1105 Commerce Building, Houston, Texas.

Promotions by "Oilwell"

M. F. (MIKE) HAZEL, formerly district sales manager for Oil Well Supply Company in East Texas, North Louisiana, and Arkansas, has been appointed assistant division sales manager with headquarters at Houston, Texas. He will supervise sales activities in "Oilwell's" Southwest Texas and Gulf Coast districts. The latter is a new district, comprising the areas formerly designated as the Houston District and the South Louisiana District. Since April, 1941, he has been

M. F. HAZEL

R. H. CHRISTY

P. H. SHEPHERD

district sales manager of the East Texas, North Louisiana, and Arkansas District, with headquarters at Shreveport, Louisiana.

RALPH H. CHRISTY, formerly district sales manager of the Houston District, has been appointed district sales manager of "Oilwell's" new Gulf Coast District. He will continue to make his headquarters at Houston.

PAUL H. SHEPHERD, formerly district sales manager for the South Louisiana area, has been appointed district sales manager of the company's East Texas, North Louisiana, and Arkansas District with headquarters at Shreveport.

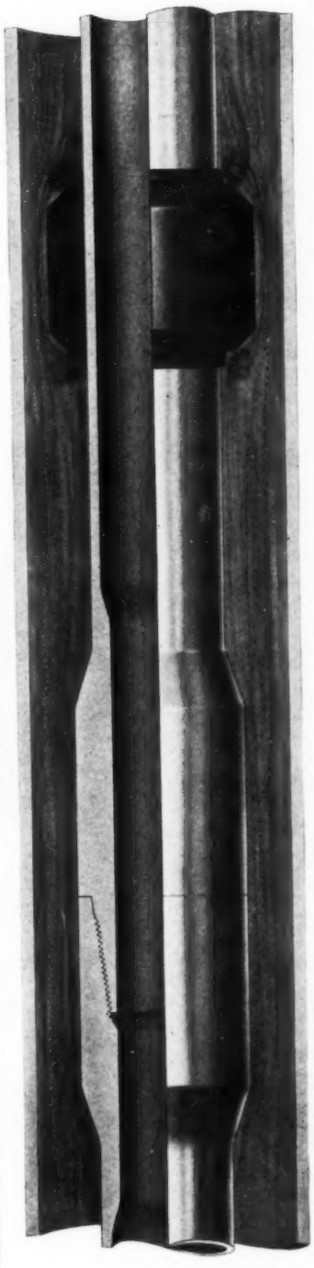
War Cancels 1942 International Petroleum Exposition

The International Petroleum Exposition, scheduled to be held in Tulsa, Oklahoma, next May has been canceled by directors of the show.

Although many of the supply men expressed the belief that the show must be perpetuated and its $550,000 assets maintained, they agreed that because of the war and troubled priority problem, the show would be abandoned in 1942.

The decision to cancel the exposition came after F. F. Murray, Oil Well Supply Company manager, declared that the unanimous vote of the 47 members of the Petroleum Equipment Suppliers Association, representing 128 members of that body and constituting more than 90 percent of oil-well supply manufacturers, was that it was not propitious.

STREAMLINE
DRILLING MUD FLOW



1. Stop the turbulence and swirling of mud that cause scouring and grooving of Drill Pipe at the ends of protectors and around tool joints.
2. Save water and mud weighting material.
3. Prevent mud from lodging between protector and drill pipe.
4. Note the lips that are molded integrally in new Patterson-Ballagh Lip Protectors. All the swirl of the mud is taken by the highly abrasion resistant lip of the Protector.
5. Add 15% more grip area.
6. One more Patterson-Ballagh contribution to the speed and economy of Drilling Wells with real savings in equipment.
7. 40,000 tested Lip Protectors show that all these advantages are enjoyed.

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Rockford Over-Center Clutches lock in or out of engagement; Spring-Loaded type works like an automobile clutch. Also available are Rockford Power Take-Offs which accommodate any type of plate clutch and fit standard S.A.E. flywheel housings. Specify Rockford Clutches!

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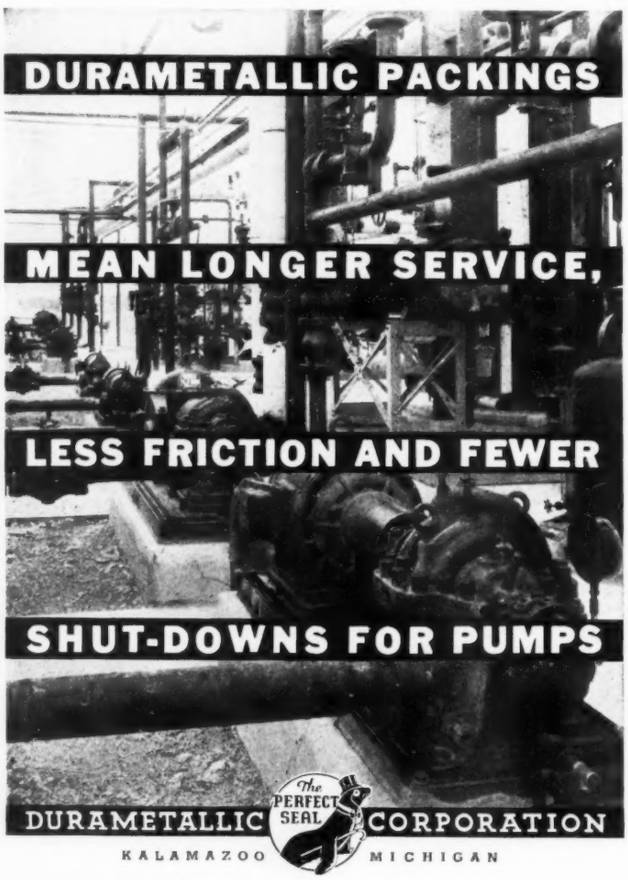


Mid-Continent District A.P.I. to Meet in Tulsa

The Spring Meeting of the Mid-Continent District, American Petroleum Institute Division of Production, will be held in Tulsa, Oklahoma, at the Mayo Hotel, March 26 and 27, 1942, it has been announced.

Committees that have been appointed to handle the various details in connection with the 1942 meeting are:

General Committee on Arrangements: H. M. Stalcup, chairman, Skelly Oil Company, Tulsa, Oklahoma; Roscoe Ayers, Bethlehem Supply Company, Tulsa; F. E. Bernsen, Lucey Products Corporation, Tulsa; P. H. Bohart, Gulf Oil Corporation, Tulsa; W. M. Bovaird, Bovaird Supply Company, Tulsa; D. E. Buchanan, Hanlon-Buchanan, Inc., Tulsa; C. W. Flint, Tulsa Rig and Reel Company, Tulsa; M. T. Gilbert, Mid-States Oil Corporation, Tulsa; Dana Kelsey, Sinclair-Prairie Oil and Gas Company, Tulsa; A. J. Kerr, Pittsburgh Equitable Meter Company, Tulsa; H. W. Ladd (ex-officio), Stanolind Oil and Gas Company, Tulsa; R. W. McDowell, Mid-Continent Petroleum Corporation, Tulsa; D. G. Mann, The National Supply Company, Tulsa; C. V. Millikan, Amerada Petroleum Corporation, Tulsa; R. B. Roark, Shell Oil Company, Inc., Tulsa; E. E. Robbins, Oil Well Supply Company, Tulsa; C. S. Sanders, Stanolind Oil and Gas Company, Tulsa; O. C. Schorp, The Carter Oil Company, Tulsa; J. L. Shakely, Frick-Reid Supply Corporation, Tulsa; D. R. Snow, Barnsdall Oil Company, Tulsa; Carl Swanson, Continental Supply Company, Tulsa; Dee Sykes, Baroid Sales Division, National Lead Company, Tulsa; W. K. Warren, Warren Petroleum Corporation, Tulsa; Al West, Continental Oil Company, Tulsa; W. K. Whiteford, British American Oil Producing Company, Tulsa, and C. O. Willson, *The Oil and Gas Journal*, Tulsa.

Program Committee: C. D. Miller, chairman, Barnsdall Oil Company, Tulsa; E. O. Bennett, Continental Oil Company, Ponca City, Oklahoma; H. F. Beardmore, Amerada Petroleum Corporation, Tulsa; Ralph Clark, Gulf Oil Corporation, Tulsa; Pat McDonald, British American Oil Producing Company, Oklahoma City, Oklahoma; J. S. Montgomery, Phillips Petroleum Company, Bartlesville, Oklahoma; R. P. Moscrip, Shell Oil Company, Inc., Wichita, Kansas, and Chas. Galloup, Texoma Natural Gas Company, Amarillo, Texas.

Publicity Committee: C. O. Willson, chairman, *The Oil and Gas Journal*, Tulsa; C. V. Barrows, *Daily Oklahoman*, Oklahoma City; N. D. Bartlett, *Amarillo Globe News*, Amarillo, Texas; Paul S. Hedrick, *Tulsa Daily World*, Tulsa; Harry E. Hoare, *The Pampa News*, Pampa, Texas; Joseph A. Kornfeld, *Wichita Beacon*, Wichita; Andy Rowley, *Tulsa Tribune*, Tulsa; Frank Taylor, *The Oil Weekly*, Tulsa, and W. Townsley, *Great Bend Tribune*, Great Bend, Kansas.

Meeting Room Facilities Committee: A. J. Kerr, chairman, Pittsburgh Equitable Meter Company, Tulsa; H. F. Beardmore, Amerada Petroleum Corporation, Tulsa, and Jack Powers, Bethlehem Supply Company, Tulsa.

Registration Committee: H. W. Ladd, chairman, Stanolind Oil and Gas Company, Tulsa.

Entertainment Committee: Dee Sykes, chairman, Baroid Sales Division, National Lead Company, Tulsa.

F. W. Morris Moved Up by Spang Chalfant, Inc.

Spang Chalfant, Inc., announces the appointment of Frank W. Morris as manager of sales, West Coast territory, succeeding J. V. Greer, resigned.

Morris' headquarters will be in the Ohio Oil Building, Los Angeles, California. Frank Morris has been associated with the Spang Chalfant sales organization for a number of years and just recently was manager of sales for the Dayton Pipe Coupling Division of National Supply Company, Pittsburgh.

Book Reviews

Sixty-Year Index, A. S. M. E. Technical Papers, 1880-1939. Published by The American Society of Mechanical Engineers, 29 West Thirty-Ninth Street, New York, New York. 200 pp. Price $3.75.

An index covering all the technical papers published in *Transactions* from 1880 to 1939 and in *Mechanical Engineering* from 1908 to 1939. More than 10,000 items were necessary to cover all the papers. The index contains 768 subject headings under which the items are chronologically arranged. Each paper is listed under as many subject heads as is required with attention directed to related articles by 700 cross-references. The author index gives the subject headings and year under which each author's paper is listed in the subject index.

•

Flow of Water in Pipes and Pipe Fittings, by John R. Freeman. Published by The American Society of Mechanical Engineers, 29 West Thirty-Ninth Street, New York, New York. 350 pp. Price $8.00.

This book contains 350 pages, 9 by 11½ in. in size, and describes the experiments and presents the computation of results, sketches and schedules of pipes, notes on the interior surface, more than 150 tables of results, and about 200 illustrations.

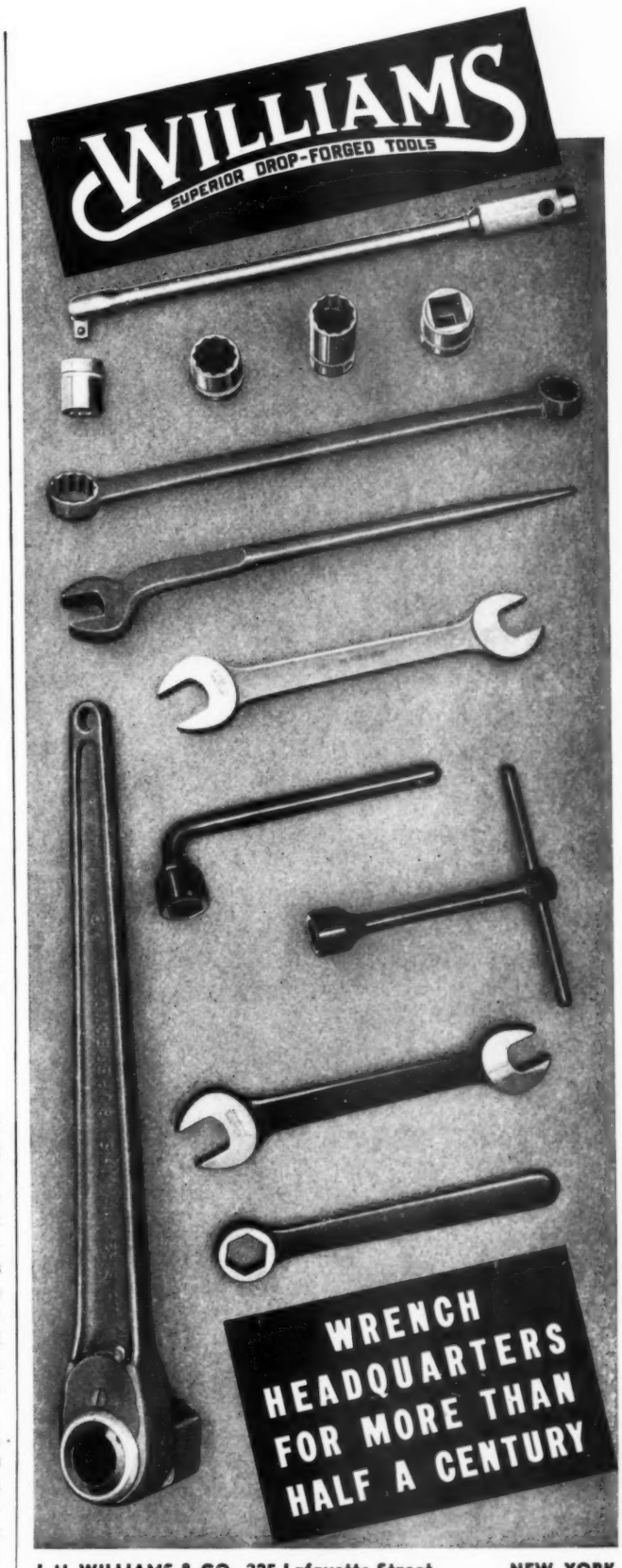
The experiments described were made in the nineties, but the results are applicable to present-day pipe and fittings. The investigation is said to be the most comprehensive single research ever made on the subject and has developed so much valuable data on artificial roughness in pipes and on pipe fittings that those interested in hydraulics and fluid mechanics will want to become acquainted with the experiments and the results obtained. Results of the experiments are compared with more recent experiments and are discussed in the light of recent developments and analysis.

Nomads Entertain at A.P.I. Convention

Marking what is destined to be the first of a series of annual cocktail parties, the California Nomads entertained visiting brethren from New York, Houston, and Tulsa chapters during the A.P.I. Convention in San Francisco. The affair, a combination buffet supper and cocktail party, was held at the San Francisco Stock Exchange Club. Strictly invitational and originally planned for 300 guests, all records were broken with a total attendance of 389. In addition to nearly 100 California Nomads and ladies, between 30 and 40 foreign oil men, together with various A.P.I. officials and prominent oil company executives were among those present. Visiting Nomads, including wives, from the New York, Houston, and Tulsa chapters totaled more than 70.

Ernie Fowks, president of the California Nomad chapter, in speaking of the affair, said: "Our executive board feels that we have taken the lead in inaugurating one more idea that will help to bring Nomads together at frequent intervals regardless of where they may travel. We are confident that other Nomad chapters will carry out the idea at subsequent A.P.I. conventions."

The arrangements committee, headed by Bart Gillespie, was comprised of Ted Sutter, Steve Bechtel, Bill Bettis, Hi Cassidy, Elmer Decker, Henry Pullman, Earl Rees, and Charles Toll.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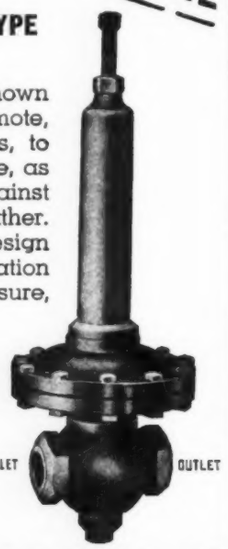

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Heads Roebling's Cleveland Branch

The John A. Roebling's Sons Company announced the retirement of Raymond R. Newell as manager of their Cleveland branch on December 1. Newell had been associated with the Roebling Company for 39 years and had been in charge of the Cleveland organization since 1911.

Eugene King, former assistant manager under Newell, has been appointed to the managership. King was first employed by the Roebling company in 1917. On July 1, 1941, he was appointed assistant manager of the Cleveland branch.

EUGENE KING

Zordrager Becomes McEvoy Sales Manager

Morey Zordrager, formerly assistant sales manager for McEvoy Company, Houston, Texas, has been promoted to sales manager. A. Henderson, formerly sales manager, is now vice-president and operating manager of the McEvoy plants.

Zordrager received his degree in chemical engineering from the University of Colorado in 1929. He worked in the research department of the Gulf Production Company and then became district engineer for the Texas Railroad Commission. From a position as sales manager of the Universal Engineering Company, he went with the McEvoy Company in 1935.

MOREY ZORDRAGER

Concurrent with Zordrager's promotion, McEvoy Company announced a redistribution of McEvoy salesmen to improve service.

Fritz Krause covers the East Texas and Northwest Louisiana areas. His headquarters are at Kilgore.

Bill Culver, with headquarters at Alice, now serves the Southwest Texas area.

L. D. McMurry serves the Houston territory.

Jerry Faubion covers the Gulf Coast area of Louisiana.

N.G.A.A. Announces 1942 Convention Committee

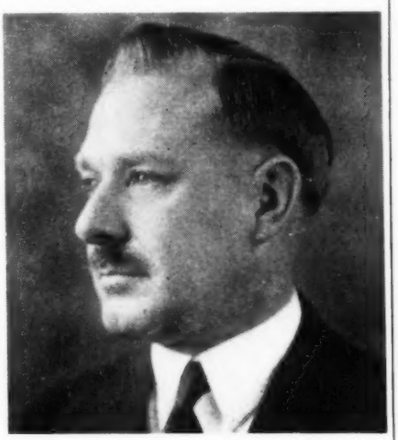
Harry Ells, general manager of natural gasoline operations, Cities Service Oil Company, Bartlesville, Oklahoma, has been appointed chairman of the 1942 Convention Program Committee for the 21st annual convention of the Natural Gasoline Association of America, according to Ray E. Miller, Hanlon-Buchanan, Inc., president of the association. The meeting is scheduled for May 13, 14, and 15, in the Mayo Hotel, Tulsa, Oklahoma.

Other members of the committee are: H. H. Beeson, Sabine Valley Gasoline Company, Inc., Shreveport, Louisiana; E. E. DeBack, The Chicago Corporation, Corpus Christi, Texas; D. M. Wolfe, Standard Oil Company of California, San Francisco; S. F. Mauney, Jr., The Carter Oil Company,

Tulsa; G. W. McCullough, Phillips Petroleum Company, Bartlesville, and R. A. Carter, Continental Oil Company, Ponca City, Oklahoma.

Walter H. Meier of Atlantic Refining Company Passes Away

Walter H. Meier, engineer with the Atlantic Refining Company in Dallas, Texas, passed away November 15.



WALTER H. MEIER

Meier was born in Washington, D. C., October 11, 1886. He was in the United States Navy from 1901 to 1907 and studied engineering at the University of Oklahoma from 1908 to 1910, leaving prior to graduation due to illness. He worked for railroad and telephone companies until in November, 1915, when he joined the staff of the Empire Gas and Fuel Company at Bartlesville, Oklahoma. He took an active part in the first World War and went to Dallas in 1920 as an engineer with the Atlantic Refining Company.

Special Representative for Kobe

Kobe Incorporated, manufacturers of the Kobe Hydraulic Pumping System, announces the recent appointment of R. A. Feemster as special sales representative for the Mid-Continent Division.

R. A. FEEMSTER

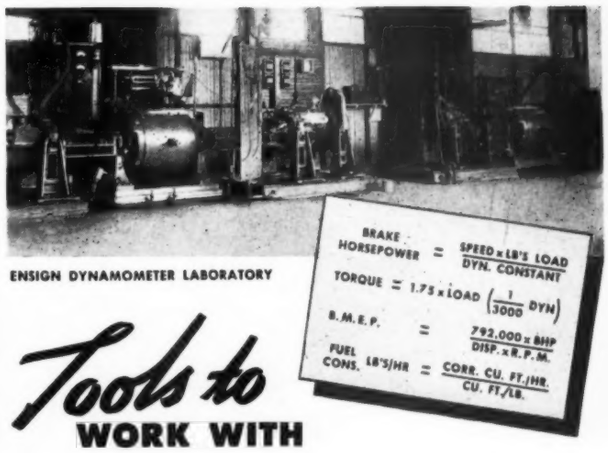
Feemster became associated with Kobe Incorporated in April, 1941, as district representative for the western Oklahoma territory.

After obtaining a B.S. degree in the School of Petroleum Engineering at Oklahoma University in 1932, Feemster was employed in the Engineering and Production Department of Phillips Petroleum Company for two years. After leaving this company, he was variously associated with oil-field equipment companies for the next five years engaged in creative work in subsurface drilling and completion projects.

Feemster will maintain headquarters in the company's division offices at Oklahoma City, Oklahoma.

Martin-Decker Establishes Canadian Service

J. E. "Johnny" Miller of the Service Engineering Company, Okotoks, Canada, has been appointed Canadian representative for the complete line of Martin-Decker drilling control instruments, according to an announcement by Martin-Decker Corporation, Long Beach, California. Miller will have charge of sales, installations and maintenance of Martin-Decker equipment used on Canadian wells.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California Topical Committee Discusses Corrosion

At a meeting of the California Topical Committee on Production Practice, American Petroleum Institute, held at the Los Angeles Athletic Club, December 2, E. M. Wagner of Kobe Incorporated led an informal discussion on "Corrosion in Sub-Surface Production Equipment." The first paper on this subject was by W. M. Henderson, superintendent of distribution, Southern California Gas Company, who discussed pipe-line corrosion and the application of corrosion studies in pipe-line operation to oil-well equipment. This was followed by the rereading of a paper on "Elementary Principles of Corrosion" by Randall Maass of General Petroleum Corporation, which the author had previously delivered before the California Natural Gasoline Association. Samples to illustrate this paper were provided by Alexander Maradudin of Standard Oil Company. Walter Main of Youngstown Sheet and Tube Company then discussed corrosion of casing, tubing, and sucker rods.

At the end of the meeting E. C. Babson of Union Oil Company was announced as the chairman for the Topical Committee on Production Practice for 1942.

Le Roi Company Passes 25-Year Milestone

Le Roi Company, Milwaukee, Wisconsin, has completed 25 years in business. The company, which began its existence in a small shop on the site of the present main building, has now grown to consist of three plants, all in Milwaukee.

Le Roi manufactures engines from 4 to 400 hp., portable air compressors from 60 to 420 cu. ft. per min., and engine-generator sets from 2 to 200 kw.

At present Le Roi Company is busily engaged in turning out defense work as each of its products is a vital factor and very essential in the attempt to build a strong national defense.

Highlights in the history of the company include the introduction by Le Roi, in 1920, of the first multiple-cylinder industrial unit to be used on construction machinery; the development of a series of oil-field pumping and drilling engines and in particular a 12-cylinder, 350-hp. engine for deep drilling; and, during the last year, the awarding to Le Roi by the U. S. Army of what is said to be the largest portable air compressor order in history ever placed with one company.

C. W. Pendock has been president and J. R. Frantz has been vice-president of the company since its inception.

Continental Oil Company Wins Safety Award

First place trophy for the best safety record in drilling operations has been awarded to Continental Oil Company by the National Safety Council. The period covered was from July 1, 1940, to June 30, 1941. The only place in which the company operates its own tools is in California and replicas of the trophy are being presented to the superintendents and tool pushers in that state.

Correction

On page 166 of the November issue of *The Petroleum Engineer*, the last sentence of the news story headed "Reader in South America Suggests Clarification of Formulas," should have read: "It is also suggested that Young should have stressed the fact that 1 hp.=33,000 ft-lb. per minute."

MEETINGS

Louisiana Engineering Society, Annual Meeting—January 9 and 10, 1942, St. Charles Hotel, New Orleans, Louisiana.

Society of Automotive Engineers, Annual Meeting and Engineering Display—January 12, 13, 14, 15, and 16, 1942, Book-Cadillac Hotel, Detroit, Michigan.

American Petroleum Institute, Division of Production, Southwestern District, Spring Meeting—February 26 and 27, 1942, Adolphus Hotel, Dallas, Texas.

North Texas Oil and Gas Association—February 28, 1942, Wichita Falls, Texas.

American Society for Testing Materials, Committee Week and Spring Meeting—March 2, 3, 4, and 5, Cleveland, Ohio.

Indiana Independent Petroleum Association, Spring Convention and Refiners' and Suppliers' Exhibit—March 3, 4, and 5, 1942, Hotel Severin, Indianapolis, Indiana.

American Petroleum Institute, Division of Production, Pacific Coast District, Spring Meeting—March 10, 1942, Biltmore Hotel, Los Angeles, California.

Wisconsin Petroleum Association, Annual Convention and Equipment Show—March 18, 19, and 20, 1942, Schroeder Hotel, Milwaukee, Wisconsin.

American Society of Mechanical Engineers, Spring Meeting—March 23, 24, and 25, 1942, Houston, Texas.

American Petroleum Institute, Division of Production, Mid-Continent District, Spring Meeting—March 26 and 27, 1942, Mayo Hotel, Tulsa, Oklahoma.

American Petroleum Institute, Division of Production, Eastern District, Spring Meeting—April 9 and 10, 1942, William Penn Hotel, Pittsburgh, Pennsylvania.

American Institute of Mining and Metallurgical Engineers—April 15, 16, and 17, 1942, Cincinnati, Ohio.

National Petroleum Association, Thirty-ninth Semi-Annual Meeting—April 16 and 17, 1942, Hotel Cleveland, Cleveland, Ohio.

Southwestern Gas Measurement Short Course—April 21, 22, and 23, 1942, University of Oklahoma, Norman, Oklahoma.

American Association of Petroleum Geologists, Twenty-seventh Annual Meeting—April 21, 22, 23, and 24, 1942, Cosmopolitan Hotel, Denver, Colorado.

Petroleum Industry Electrical Association—April 22, 23, and 24, 1942, Shreveport, Louisiana.

Natural Gasoline Association of America—May 13, 14, and 15, 1942, Mayo Hotel, Tulsa, Oklahoma.

American Society of Mechanical Engineers, Semi-Annual Meeting—June 8, 9, 10, and 11, 1942, Cleveland, Ohio.

American Society of Mechanical Engineers, Fall Meeting—October 12, 13, and 14, 1942, Rochester, New York.

American Petroleum Institute, Annual Meeting—November 9, 10, 11, 12, and 13, Chicago, Illinois.

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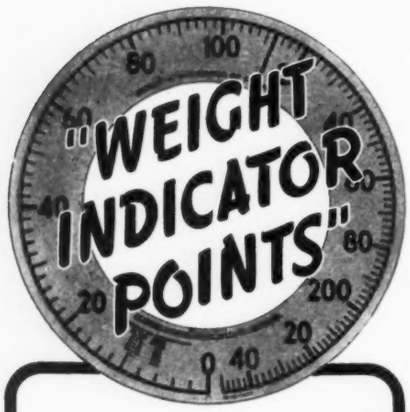

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